THE REFINER AND NATURAL GASOLINE MANUFACTURER

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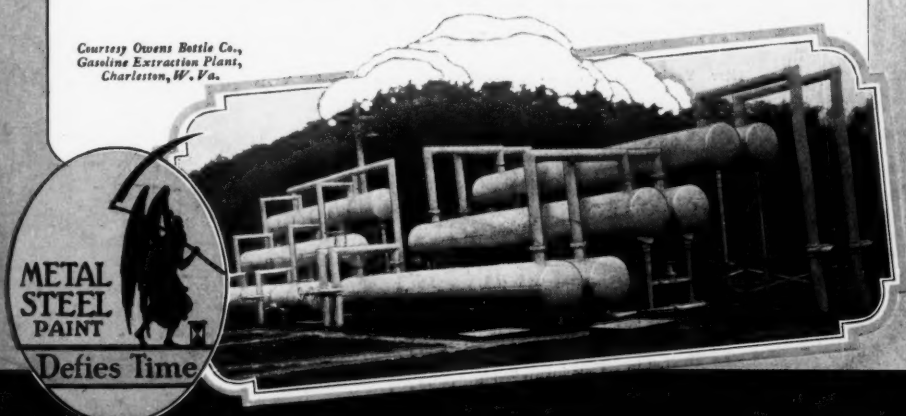

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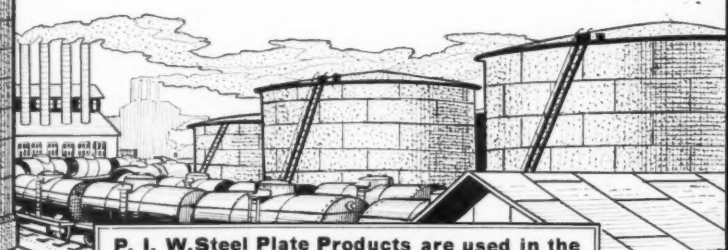

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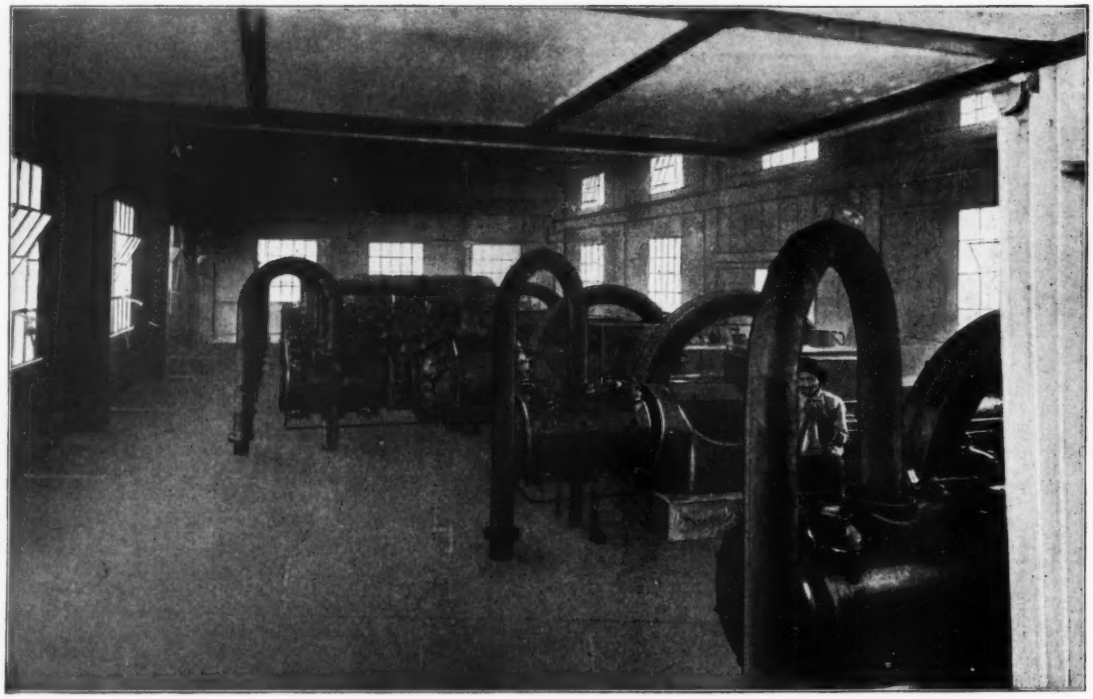

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Refining Cracked Distillates vs. Light Oils

Sulphuric acid treatment used with the proper modification gets specification gasoline from cracked hydrocarbon oils

DURING the year 1923 there will be produced approximately 2,100,000,000 gallons of cracked gasoline passing commercial tests for use in automotive engines. This quantity of cracked gasoline will have been refined by means of sulphuric acid. To refine 2,100,000,000 gallons of cracked gasoline approximately 125,000 tons of sulphuric acid will be required. To neutralize the sulphuric acid and organic acids 75,000 tons of caustic soda will be needed.

To treat out the sulphur compounds in the cracked oils sufficient to pass the "Doctor Test" 12,000 tons of litharge and 9000 tons of flowers of sulphur are the needs of the petroleum industry during the year 1923, to market over two billion gallons of cracked gasoline.

It can be said that the idea is prevalent that cracked hydrocarbon oils are not amenable to treatment by the ordinary methods now used for treating straight run distillates. It is the purpose of this investigation to show that the refining of cracked distillates is simply a special case in the refining of light oils in general. Bearing in mind the differences in composition between cracked and straight run oils, it is possible by reasonable modification of the sulphuric acid treatment to obtain water white gasoline of sweet odor, passing all specification tests. It is further the object of this paper to present a general method for the treatment of all types of cracked hydrocarbon oil.

By far, however, the most widely used and most successful method both from an economic viewpoint, as well as from the viewpoint of results obtained, is the sulphuric acid method of refining. This method, which is as old as the petroleum industry itself, is one with which the experimental portion of this present paper chiefly concerns itself, and a modification of which has been found to be feasible in the successful treatment of various types of cracked hydrocarbon oils.

The object of refining in general is to remove certain impurities in the oils, which make the use of such oils objectionable. In some cases the actual value of the oil may not be improved from the viewpoint of the purpose to which it is to be applied. However, there are certain criteria to be met commercially, namely, absence of color or water white product, a sweet odor in the case of gasoline. This is particularly true of the treatment of cracked distillates, although in general what applies to one type of oil applies to the other.

An outline of the method of treating with sulphuric acid is given below. Preliminary to this discussion, however, it may be profitable to indicate the accepted ideas regarding the action of sulphuric acid on the various compounds which go to make up these hydrocarbon oils.

It is generally believed that sulphuric acid is without effect on the paraffins and naphthenes. There are exceptions to this belief however. McKee[1] cites the information of disulphonic acid from the action of sulphuric acid on paraffin hydrocarbons, such as kerosene. The question arises whether the kerosene used was washed completely free of the olefin hydrocarbons.

Grimm[2] states that although methane is not attacked by sulphuric acid containing up to 15 per cent of sulphur trioxide, ethane was completely dissolved by repeated shaking with the acid containing 12 per cent of sulphur trioxide. The latter is also true of propane, butane, and iso-butane. Various results were obtained with respect to the action of sulphuric acid toward the liquid homologues.

Lehmann[3] found that hexane and pentane dissolved in sulphuric acid containing 12 per cent sulphur trioxide.

Sentke[4] obtained no reaction with normal pentane, iso-pentane and normal hexane, unless he used acid containing as much as 40 per cent sulphur trioxide.

Lehmann and Sentke[5] later showed that with the exception of methane all of the homologues are easily attacked by sulphuric acid containing much anhydrous sulphur trioxide and that solubility increased with increasing percentages of sulphur trioxide and higher temperature.

Concentrated sulphuric acid reacts only with the lower members of the naphthenes. Markownikoff[6] has shown that cyclo-propane, methyl-cyclo-propane and 1,1-dimethyl-cyclo-propane are dissolved in sulphuric acid. Some naphthenes are partially dissolved and oxidized forming aromaticmono-disulfo-acids, resins and products volatile with steam.

Starke[7] found that naphthenes of the fraction from 130 to 260° are converted with sulphuric acid (96%) into sulfo derivatives of benzene which by steam distillation yield benzenes.

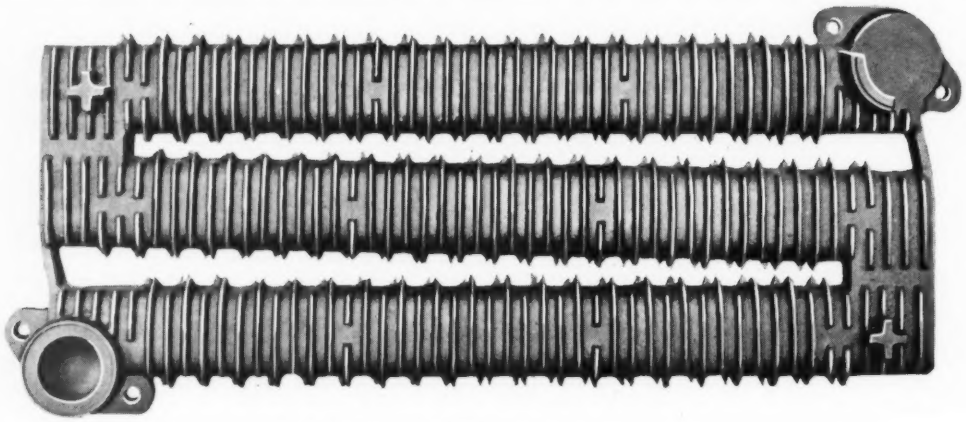
Regarding the aromatic hydrocarbons, cold concentrated sulphuric acid attacks them only slightly. However, Brooks and Humphrey[8] and others have found that the homologues of benzene react with fuming sulphuric acid.

With respect to the effect of sulphuric acid on the unsaturated hydrocarbons, it is generally believed that the two most important reactions are the formation of alkyl sulphuric acid or neutral sulphuric esters, and polymerization of the unsaturated hydrocarbons. The alkyl sulphuric acids and neutral esters when boiled with water decompose into the corresponding alcohols and sulphuric acid.

Von Pilat and Starkel[9] state that sulphuric acid reacts principally as a polymerizing agent on the unsaturates. Since the products are more soluble in the acid, they are removed from the distillate. The formation of sulfo-acids is considered as a secondary reaction due to the decomposition of the acid.

Brooks and Humphrey (loc. citi) have shown that oplymerization, as well as formation of secondary and tertiary alcohols and the alkyl esters of sulphuric acid, take place when unsaturated hydrocarbons are treated

[1]McKee, Chem. Ztg. 36,872-3, (1912.)
[2]Grimm, Dissertation Karlsruhe-Basel (Engler Hofer I, 231, 1913), (1897.)
[3]Lehmann, Dissertation Karlsruhe-Freiburg (Engler Hofer I, 231, 1913), (1897.)
[4]Sentke, Diplomarbeit, Karlsruhe (Engler Hofer I, 232, 1913), (1907.)
[5]Lehmann and Sentke, Engler Hofer I, 233, (1913.)
[6]Markownikoff, Chem. Centrabl. (II, 578 I, 1345.) (1898.) (Engler Hofer I, 281, 1913) (1904.)
[7]Starke, Chem. Tech. Rep. 209, (Engler Hofer I, 282, 1913), (1909.)
[8]Brooks and Humphrey, J. A. C. S. 40, (5), 822, (1918.)
[9]Von Pilat & Starkel, Petroleum, 6, 2177, (1911.)



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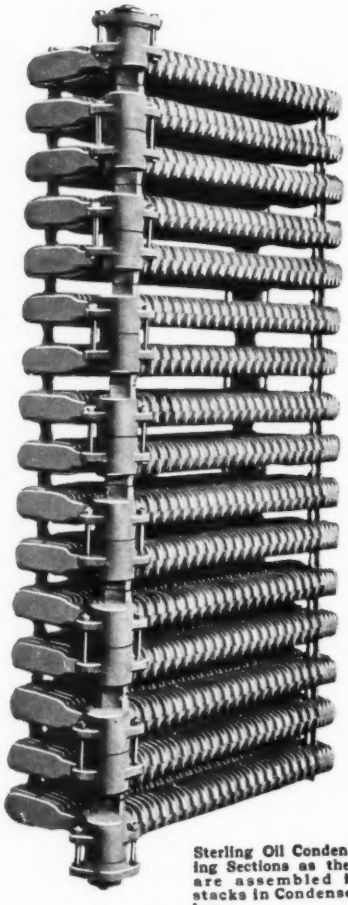

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with sulphuric acid. They also postulate the formation of additive molecular compounds of the olefins and their isomers, with sulphuric acid. They further show that no tars are formed by the treatment of any pure olefins with sulphuric acid at 15°C. The polymers of olefins are frequently di-olefins and in all cases still contain at least one double bond and these unsaturated hydrocarbons of high molecular weight, that is, the polymers are much more stable towards sulphuric acid than the parent olefins. The fact that these polymers are relatively stable has the result that they are not removed with the acid sludge but are found to a large degree in the oil layer, that is, the refined oils.

Some of the di-alkyl esters of sulphuric acid are also found in the refined product. These esters are neutral and are not removed by washing with aqueous alkalies.

Brooks and Humphrey (loc. cit.) have shown further that the proportion of these sulphuric esters in the refined product is roughly inversely proportional to the relative amount of sulphuric acid employed. Similar treatment of chemically pure higher homologues of the olefin series result in the formation of a two layer system, indicating little or no effect.

Regarding the refining of motor spirits and kerosene, Brooks and Humphrey (loc. cit.) show that in the light of the above results it is clear that those grades which are completely soluble in sulphuric acid at ordinary temperature, must consist of the lower members of the olefin series. Where oily layers insoluble in the acid are produced, either the acid treatment is not carried sufficiently far or the oil contains a certain proportion of higher homologues of the olefin series, paraffins, naphthenes or aromatic hydrocarbons.

The reaction which takes place in the treatment of cracked distillates is a problem which involves the chemistry of all types of hydrocarbons. With respect to the action of sulphuric acid upon the individual groups it is well that the percent of unsaturated hydrocarbons, or rather the percent of hydrocarbons absorbed by concentrated sulphuric acid, at room temperature in cracked hydrocarbon oils, is relatively high usually from 8 to 17 per cent. The statement has been frequently made and it is generally believed, that these latter substances are very much reduced in quantity when cracked distillates are treated with sulphuric acid. The following table in connection with the present work does not bear out this general belief:

Cracked Distillate from—	Per cent Unsaturates Absorption by Sulphuric Acid Treated oil	Untreated oil
Mid-Continent Gas Oil	13	12
Mid-Cont. Kerosene Dist....	15	14
Mid-Continent Fuel Oil.....	12	10
California Gas Oil	13	12
Mid-Con't. Topped Crude ..	11	10
Louisiana Fuel Oil	12	10
Louisiana Topped Crude ...	9	7
Ranger Topped Crude	12	12
Burkburnett Fuel Oil	16	14
Healdton Crude	8	7
Tarakan Crude	12	10
Fremont Crude (Wyoming)	16	14
Mexican Gas Oil	17	15
Gas Oil from Mex. Crude...	13	10
Mexican Crude Distillate ..	15	13
Illinois-Kentucky Fuel Oil..	15	14

Attention has been called in the literature from time to time to the high losses occurring when cracked distillates and other light distillates are treated with sulphuric acid. This loss is attributed not only to the actual solution losses resulting from the sulphuric acid treatment, but also, to the losses by polymerization resulting in a lower gravity material and of higher end point. These polymers remain to a great extent in the treated oil.

Brooks and Humphrey (loc. cit.) show oil losses in the sulphuric acid treatment of presure distillate varying from 3 to 20 per cent. The latter figure is applied to the treatment of Scotch shale oil. Other figures sited show losses varying from 9 to 28 per cent.

The writers wish to point out that the maximum loss sustained in this work on pressure distillate was less than 3 per cent and that when it is considered that the mechanical losses due to handling as determined by a blank treatment on each of the distillates in question that the loss would be between 1½ and 2 per cent.

Regarding the polymerization, losses, i. e., losses which are attributed to the polymerization of the unsaturated hydrocarbons, it is to be pointed out that such loss is not as great as one may be led to believe.

In working out extreme conditions for polymerization Brooks and Humphrey find values of from 15 to 30 per cent based upon a study of boiling point ranges of treated and untreated gasoline.

In connection with the present work it may be significant to point out that based upon changes in the specific gravity of the pressure distillate before and after treatment the maximum increase in density or decrease in volume was 0.7 per cent. It is reasonable to assume that this increase in density or decrease in volume in a measure of polymerization. The table below shows this change in gravity over the whole series of oils treated.

In connection with the above it is to be remembered that mechanical losses of low boiling point hydrocarbons if any, would be in the direction which would favor an interpretation as polymerization.

In the refining of cracked distillates by sulphuric acid it is to be recalled that the treatment precedes distillation as pointed out later, and if the oil is properly distilled and fractionated a full recovery of end point gasoline may be expected.

The work of Brooks and Humphrey (loc. cit.) was done on gasoline from cracked distillates. In such cases the sulphonated hydrocarbons instead of remaining in the bottoms for the most part remain in the gasoline and bring about polymerization forming resin like substances which raise the end point of the gasoline. However, when the original distillate is treated sulphonation as far as the gasoline is concerned occurs to a much less extent for the same amount of acid used on account of the gasoline being diluted with the heavier hydrocarbons.

Even considering the above when an excess of acid is no used the end point of the gasoline is not increased an unreasonable amount. A gasoline from a cracked fuel oil showed an increase of only ten degrees F. in the end point i. e., from 440° F. to 450° F. when treated with 0.55 per cent of acid by volume which was entirely sufficient to produce a gasoline of good odor and water white color when the pressure distillate was treated and redistilled. In connection with the experiment it is to be remembered that the loss on treating was 1.2 per cent and that the gasoline had stood for some time after treating before distilling.

Variable Conditions of Treatment

Altho, various strengths of acid as low as 63 Be. (83.3 per cent) will give very good products and good results may be obtained in some cases with fuming sulphuric acid, it has been found advisable for several reasons to use 66 Be. sulphuric acid (95 per cent sp. gr. 1.84). Among these reasons is the fact that ordinary commercial sulphuric acid is shipped in this form, that there is less chance for the equipment being attacked by this strength as well as by sulphuric acid of higher concentration and that in general good results may be obtained with any type of pressure distillate using this 66° Be. acid.

The quality of acid used in treating cracked hydrocarbon oils varies from 1 to 7 pounds per barrel of the pressure distillate. It has been found good practice to apply the acid in several applications, the reasons for this being apparent. The heating effect due to the reaction of a large quantity of acid, is much greater than when the same quantity is applied in several applications; further better results have been obtained by this method.

The refining power of the acid is not proportional to the quantity used. If too great a quantity of acid is used with cracked distillates the latter are apt to become fixed in color or to be "burnt," using a refinery term. The range is quite wide, however, and a preliminary trial will indicate the approximate quantity necessary. For example, a Mid-Continent pressure distillate which required only 1½ pounds of sulphuric acid per barrel still gave good results with six pounds per barrel.

Where fuming sulphuric acid is used in the treatment of cracked distillates, and it may be pointed out that in the experience of the writers it is never required, about 1/5 less in weight is re-

Cracked Distillate From—	(a) Sp. Gr. Before Treatment	(b) Sp. Gr. After Treatment	Ratio a : b	Per Cent Decrease in volume
Cushing Gas Oil	0.789	0.794	0.9938	0.6
Mid-Continent Gas Oil	0.785	0.790	0.9933	0.7
Mid-Continent Kero. distillate	0.791	0.797	0.9927	0.7
California Gas Oil	0.842	0.846	0.9959	0.4
Mid-Continent Fuel Oil	0.793	0.796	0.9961	0.4
Mid-Continent Topped Crude	0.768	0.772	0.9946	0.5
Louisiana Fuel Oil	0.763	0.768	0.9935	0.6
Louisiana Topped Crude	0.765	0.769	0.9942	0.6
Ranger Topped Crude	0.763	0.767	0.9945	0.5
Burkburnett Fuel Oil	0.768	0.772	0.9946	0.5
Healdton Crude Oil	0.785	0.789	0.9956	0.4
Tarakan Borneo Crude	0.836	0.844	0.9905	0.9
Fremont Crude (Wyoming)	0.769	0.770	0.9956	0.4
Mexican Gas Oil	0.816	0.821	0.9942	0.6
Gas Oil Mexican Crude	0.795	0.798	0.9966	0.3
Mexican Crude Distillate	0.767	0.771	0.9951	0.5
Illinois-Kentucky Fuel Oil	0.758	0.764	0.9931	0.7

quired as compared with 66° Be. acid. The losses are however, correspondingly high with the fuming sulphuric acid.

With respect to the effect of the temperature at which the acid treatment is carried out it is of course understood that the treatment should be carried out at as low a temperature as possible, owing to the losses involved at higher temperatures.

Action of Light and Oxygen in Refining

Altho, light may have some effect in the treatment of cracked distillates, in practice it may be disregarded since light factors do not enter to any appreciable extent.

Regarding the action of light on the color of the oil during the refining Wischin[10] assumes that the acid asphaltic substances are susceptible to molecular rearrangement under the influence of actinic rays. However, the reservation is made that light is without effect on these asphaltic bodies in the original state and that the influence begins on the compounds formed by these asphalts with sulphuric acids. The effect is looked upon as a reduction of sulphuric acid thru sulphur dioxide to sulphur which combines with the asphaltic bodies much as do asphalts produced from petroleum residues when acted upon by sulphur or hydrogen sulphide.

Zaloziecki[11] states also that the influence of light on the formation of asphaltic substances is probably in direct proportion to the amount of sulphur present in combination but since the compounds which are formed tend to be insoluble some other explanation of the deepened color must be sought.

Ostiejko[12] states that certain types of Russian petroleums on exposure to air and sunlight deposit a yellow sediment and become strongly acid giving off a penetrating odor. He further, states that light facilitates the absorption of air by the oil.

Regarding the effect of impurities in the sulphuric acid, those which have been pointed out as being particularly injurious are the oxides of nitrogen and selenium dioxide. These cause a darkening color of the oils.

Charitschkow[13] states that the presence of nitrous acid in as low a concentration as 0.2 per cent is injurious. Nitric acid in slightly higher concentration does not effect serious injury. Organic matter is without appreciable effect.

Krey[14] finds that the presence of arsenic in sulphuric acid seems to have no deleterious effects on the treatment.

Mechanical Arrangements for Treating

The ordinary sulphuric acid treatment, where no sulphur compounds are present in cracked hydrocarbon oils, simply consists in agitating the oil with the acid, either by mechanical means or by means of air agitation, water washing the resultant oil after allowing the sludge to settle, and taking off this sludge. The oil is then agitated with caustic soda washing with water before and after and finally distilling usually in the presence of steam, straight fire or both.

However where much sulphur bodies are present additional treatment must be applied. Such treatment will be described later.

The actual mechanical arrangement for the treating of petroleum distillates may be grouped under two (2) headings, Batch Treatment and Continuous Treatment. For the former, agitation is carried on in vertical cylinders with conical bottoms. In most cases the agitators are lead lined, the thickness of the lead sheet being from 3/16 to ¼ inch.

Regarding the methods of mixing or agitation the three following methods in general use are to be pointed out; mechanically driven paddles, the use of circulating pumps usually taking suction at the top of the agitator and bringing oil in at the bottom, and agitation by compressed air. The last method is the one in common use at present, altho the losses involved in its use are very high. An improvement upon the last method is the use of a closed agitator making use of a blower to circulate air or flue gas for agitation. The loss by evoporation is very greatly cut down by this method.

The agitators are usually emptied thru a three-way branch pipe with large openings to allow passage of the waste materials by suitably adjusting the valves. The sludge acid, or alkali and oil thus being carried to their proper receptacles. Water washing is usually effected by sprinkling the water thru the oil, the sprinkling arrangement being at the top of the agitator. The washing is continued until the outflowing water gives only a slightly acid reaction. The methods of agitation have been referred to previously.

In continuous refining a great many different systems have been devised. One that is feasible is operated as follows: The distillate to be treated is pumped into a series of tanks containing acid. The oil is introduced at the bottom of the tanks, the latter being closed on the top with an outlet valve to take care of excess pressure. The oil is overflowed from one tank and passes thru the acid at the bottom of the second tank. Three such tanks are used. An alternate method to this and one that is preferable is to pump the oil and the acid properly proportioned thru a mixing coil and from there into an acid mixing and acid settling tank. The oil finally overflows into a wash tank, water being sprayed down thru the oil and drawn off by a valve at the bottom. From this tank the oil overflows into a tank containing caustic soda usually about one-half full, from whence it flows into another washer tank and then into a settling tank. For straight run distillates the oil is usually steam distilled at this point, or straight fire or a combination of both.

Where it is necessary to give a plumbite treat the plumbite and oil are pumped in together into a settling tank regulating the quantity of the plumbite or the oil may be pumped thru the plumbite at the bottom of the tank. From the plumbite tank it may be passed through a second plumbite tank then into settling tanks and finally in a wash tank.

In some cases continuous treating is carried on only with respect to the acid treatment, the alkali treatment being carried on in about the same manner as batch treating. The acid and oil from separate tanks are pumped countercurrent into an agitating tank, agitation being effected by the force of the pump. The tanks are closed and the mixed liquids, namely, the acid and the oil over-flow into a second tank into which fresh acid and oil are being pumped countercurrent to each other. The mixture is then run into a settling tank where the sludge is separated out.

In other cases the reagents, namely, the acid and the alkali, are mixed with the oil in rotary pumps. The acid, of course, being mixed first with the oil and after being run into a separating tank or thru a series of tanks the oil is mixed with the alkali in the same manner.

The mechanical methods described above as applied to light distillates may also be applied to cracked hydrocarbon oils.

It has been the purpose of this investigation to generalize the treatment of light distillates including cracked hydrocarbon oils. With this idea in mind the outline of a 1400 barrel treat applicable to all types of light distillates including pressure distillate is shown. It is usual to make use of an agitator with conical shaped bottom fitted with drawoff valve. The oil is introduced into the agitator and sulphuric acid usually 66° Be. added or the oil is introduced at the bottom after the acid is in the agitator. The amount varies from one to seven pounds of acid per barrel, depending on the type and nature of the oil. The mixture is agitated by the use of compressed air which is introduced thru a line in the apex of the cone. In some cases a small shield is placed on this line a short distance from the outlet in order to break the air bubbles and effect more even distribution of the acid. The acid is usually applied in several "shots" or doses. With regard to the length of time necessary to agitate a 1400 barrel treat, usually 30 minutes to 1 hour is required, altho, where 98 to 100 per cent acid is used this time may be shortened. After this operation the oil is allowed to stand from ½ to 1 hour or so depending on the nature of the oil in order to allow the acid and sludge to settle out. It is then sprayed with cold water, the spray passing down thru the oil and being drawn off continuously at the bottom, this takes about 30 or 40 minutes. This wash may be continued for one or two hours, the more thorough the water wash, the less alkali of course being in subsequent washes. With thorough water washing it is possible to use as low as 10 gallons of 4° Be. caustic for every 100 barrels of oil (140 gallons for every 1400 barrels of oil). Experiment has shown that eight water washes in batch will render the oil neutral, altho, it must be pointed out that the oil still contains tracts of sulphuric acid derivatives.

If the oil contains a high content of sulphur of the type which react with the so-called "Doctor Solution," it is treated with a solution of litharge in caustic soda.

In general the refiner is concerned with meeting specification tests, with regard to odor, color, the doctor test and the corrosion tests and is less concerned with the type of compound present.

It is owing to the presence of sul-

(Continued on page 11.)

[10]Wischin, Chem. Rev. Fett und Harz. Ind. 26, 1-4, 27, 3-5.

[11]Zaloziecki, Chem. Rev. Fett. und Harz. Ind. 30, 1-4.

[12]Ostiejko, Trudy Bak. Otd. Imp. Russk. Tech. Obs. 10, (4), 19. (Jour. Soc. Chem. Ind. 15, 345), (1896.)

[13]Charitschkow, Chem. Rev. Fett. und Harz. Ind. 13-15, (1906.)

[14]Krey, Chem. Ztg. 10, 1272, (1886.)

Most Any Crude Will Make Absorption Oil

Process of refining has more to do with quality of product than grade of oil used

By Harry Pennington

LARGE quantities of absorption oil being used in manufacturing natural gasoline has led to testing of various crude oils in the refinery to ascertain if a suitable oil could be had. The impression has been general that only certain crudes would make this oil because of the high initial boiling point and relatively high gravity required, but being an overhead product the general statement that absorption oil can be made from any crude that will make export kerosene is true.

The process of refining has more to do with the quality of oil manufactured than the crude. There are some crudes, to be sure, that cannot make but inferior absorption oil because of high sulphur content, but the average skimming crude which is necessarily of good grade makes a good absorption oil.

The requirements in practice for absorption oil are: high initial boiling point, relatively high gravity, no unsaturated hydrocarbon content, low emulsification, and low cold test.

The high initial boiling point requirement is to prevent vaporization of the absorption oil in the still of the gasoline plant and carrying over into the product of the lighter portion of the absorption oil. Carried over, this oil raises the end point and causes an irregular running product. Still temperature in the absorption plant runs from 240 to 260° F. with a goodly quantity of steam and an absorption oil with initial of at least 450° F. in the Engler flask is necessary to prevent carrying over some of the light ends of the absorption oil with the heavy ends of natural gasoline.

Engler Flask Test

Testing in the Engler flask is for the purpose of determining the temperature at which the absorption oil will be vaporized in the still and carried over in the condenser of the gasoline plant and there is a good deal of difference in the result of distillation in the flask as compared with steam distillation in the still. Steam, as we know, not only reduces temperature, but also carries over some of the vapors mechanically. The best test is, of course, in use but since this is not practicable, it seems that a test of absorption oil to duplicate operating conditions would serve for this purpose better.

As run in the average laboratory, the method of making this test varies; some chemists will bring the temperature up rapidly, securing a lower initial than when temperature is brought up slowly by other equally as competent chemists.

The knockout box of the gasoline plant performs the same function that the vapor tower does in the refinery but the knockout box has not yet been subjected to the refinements that the refinery tower has. While temperature in the knockout box is carried from 190 to 210° F. and condensates, theoretically, should drop out at that temperature, still there is only one fractionation at this point, only one box with one back trap and we know that a close fractionation has not yet been made in this manner. Consequently, the lighter fractions of the absorption oil will be carried over if the initial boiling point is too low, so that the sure method of separating as widely as consistently possible the initial of the absorption oil from the end of the natural gasoline is used.

An end point of 375 is sought in the gasoline product and therefore, with a 450 initial boiling point absorption oil, there is a difference of 75° F., with the same testing method.

In making quotation covering this oil the exact method of testing should be clearly stated so that the purchaser may run his test in the same manner upon sample submitted and compare with his method.

While the same apparatus, the Engler, is used in testing gasoline as well as absorption oil, test for the one is to determine volatility as affecting the complete vaporization of gasoline in the carburetter, while for the other, test is to determine volitilization under high temperature; high volitility is desirable in one and low in the other.

Gravity Indicates Viscosity

The gravity of absorption oil is an indication of viscosity and also of the presence of paraffin. This incoming casinghead gas contains more or less moisture and, at the warmer seasons, this gas is warmer than the absorber, so that when the absorber cools the gas, some moisture is condensed into the absorption oil. Moisture in the gasoline plant is more troublesome than moisture in the refinery. In the gasoline plant the heat exchanger is usually made of double pipes, so that there is continual agitation when passing through. The saturated absorption oil usually passes directly from exchanger into the still without an opportunity of settling out water as is the case in the usual refinery exchanger, although this improvement may be added to the gasoline plant in the near future. Some gasoline plants pass the cool saturated absorption oil from absorber into an open vent tank so that the fixed vapors may volatilize and pass out, since these are detrimental in stills and condensers, and it is here that separation of water and oil is expected.

We know that water settles out of low viscosity oil better and more quickly than in oils of higher viscosity, so, for satisfactory use under these conditions, a relatively high gravity indicating a corresponding low viscosity, is necessary for separation.

Should Be 40 Be.

This gravity should approach 40 Be., although some plants can use an oil throughout the year with gravity as low as 34 Be. The average gravity of good absorption oils ranges between 37 and 39 Be.

Since natural gasoline should pass the doctor test, there should be no unsaturated portion of the absorption oil, because some of these unsaturated hydrocarbons will pass over into the finished gasoline. Some gasoline plants make natural gasoline that is always sweet, due to the use of first grades of absorption oil. These unsaturated compounds will also reduce the color of natural gasoline three or four numbers. Since natural gasoline, except in the case of some California plants, is not treated or filtered, a water white, sweet product precludes the use of any but sweet absorption oil.

By carefully distilling absorption oil in the refinery to avoid cracking and using the proper amount of steam, a minimum of unsaturated hydrocarbons results and, by treating with acid and neutralizing in the agitator, this minimum can be removed.

Some California gasoline plants filter their product through clay to secure color although, perhaps, a better design of plant and better selection of absorption oil would secure the same result without filtration.

Emulsification

As noted before, moisture in the incoming gas is condensed partially in the absorber. If the absorption oil is of too low gravity, or has a paraffin content sufficient, or has an appreciable unsaturated content, emulsification results. Emulsification not only causes still troubles, just as b.s. does in the refinery still, but also reduces the percentage of saturation. The percentage of gasoline absorbed by oil in the absorber is maintained as high as possible, since there is a greater recovery of gasoline content of the gas as well as a reduction in the quantity of oil circulated per thousand feet of gas, with a high percentage af saturation. Consequently, there should be as little emulsification as possible of the absorption oil with water.

The emulsification test is run with distilled water and it would appear that the same condition would be found in the gasoline plant. But, as a matter of fact, most of the water vapor in casingread gas is from wells making water charged with various salts. These alkaline salts undoubtedly come over into the plant with the gas in sufficient quantity, small to be sure, to increase emulsification.

Much of the trouble of gasoline plants comes from emulsification. As designed, the gasoline plant should strip the gas of gasoline. And, under ideal operating conditions, the well designed plant will do this. But, temperature of the atmosphere changes greatly during the 24 hours and moisture condensation is greatest during the night when the atmospheric temperature is lowest. Emulsification may be found at this lowest temperature, while, during the day, say in the middle of the afternoon, perhaps no emulsification will occur.

Reduces Recovery

In one plant, discharging residue back to a lease, emulsification reduced the

Some close-up views of one of the first natural gasoline plants to be built in Oklahoma, a print of which appeared as a frontispiece in the May REFINER. The plant was built largely from rocks taken from the near by hills. Pictures are furnished through the courtesy of F. G. Weller Leonard, Oklahoma, formerly superintendent of the plant

recovery so much that another plant purchased the residue gas and secured a higher recovery from the residue than the first plant did from the same fresh gas. The second plant had no emulsification.

Demusibility of one minute should be taken as a maximum, otherwise the recovery is reduced a great deal more than the cost of good absorption oil.

Low cold test, from the foregoing, is seen to be imperative. An oil showing cloud at operating temperature of the gasoline plant is sure to result disastrously, reducing saturation and resulting in emulsification.

As we know, paraffin has a distillation range similar to crude oil and begins to come over in distillates from kerosene down. The paraffin content of some crude oils runs high, as much as 15 per cent is recorded, but the average crude oil contains from four to eight per cent of paraffin. In this is included the amorphous waxes that have a low melting point relative to crystalline wax.

In general, crudes with high paraffin content will produce absorption oil with a high cold test, since the low cold test fractions of paraffin are apt to come over first.

Although these can be fractionated by refrigeration into close cuts, some of the higher cold test fractions pass over into the refinery condenser along with those of lower cold test, and no close cut can be made here. The same effect, that of not being able to make a close fractionation, is had in separating paraffin fractions as in separating fractions of oil.

We know that there is a small paraffin content in fractions from 37 Be., and below in most crude oils and thus gravity is an indication of cold test also.

Cold test of 30° F. may be taken as a maximum for securing freedom from this trouble and this test is not difficult to obtain from the average crude oil.

The refining of absorption oil is for

Refining Cracked Distillates vs. Light Oils

(Continued from page 8.)

phur compounds as well as to the presence of nitrogen compounds that the odor in oils is due.

Mabery and Smith[15] as well as others, have shown that a meterial reduction in sulphur compounds or in sulphur content results from the sulphuric acid treatment.

On the other hand Dunstan and Brooks[16] state that when small proportions of sulphuric acid are employed for treating cracked gasoline, a substantial increase in sulphur content is brought about owing to the formation of alkyl esters.

However, in general practice use is made of a solution of lithage and caustic soda, producing sodium plumbite for the removal of certain types of sulphur compounds referred to. The amounts usually made use of vary from 4 to 10 pounds litharge per 100 barrels of oil (125 to 150 pounds of litharge dissolved in four to five hundred gallons of 12° to 30° Be. caustic soda for 1400 barrels of oil). For oils containing a high per cent of sulphur a larger amount is used, up to 10 per cent by volume of the oil treated, excess material can of course be recovered. The best practice has been to make up a solution in a separate tank using a slight excess of litharge over the amount that will go into solution.

The practice in this respect varies considerably. In some refineries the oil to be treated is agitated with caustic soda and while agitating the litharge is added. This plainly entails an enormous loss of litharge in addition to preventing its efficient solution in the caustic soda. The reason for this is apparent. The passage of the litharge thru the oil which is being treated causes it to be wetted by the latter, which prevents its effective solution in the sodium hydroxide. The excess litharge whether introduced in this manner or in any other manner as for example suspended in the sodium hydroxide becomes mixed with the lead sulphide and other reaction products as well as flowers of sulphur, which is sometimes later added as a precipitating agent in the case of straight run distillation. These impurities render the litharge practically unfit for further use. It may be pointed out here that in making up the solution of litharge in caustic soda or sodium hydroxide, that the former is only slightly soluble in the latter (about 3 per cent in a solution of sodium hydroxide of 30° Be. Gr.). The litharge is effective only in the peculiar state of combination in which it exists in solution in sodium hydroxide, namely as sodium plumbite, so that a great excess is simply waste. It may, however, be beneficial to have a slight excess of litharge in order to insure saturation of the sodium hydroxide, as well as the possible precipitating effect of the suspended litharge.

The solution of litharge in caustic soda is pumped over into the agitator containing the oil and vigorously agitated for about 40 to 50 minutes by means of the air current. Since the excess plumbite solution may always be recovered by settling out the impurities it is always advisable to use an excess in this treatment. It is to be noted that for cracked distillates the plumbite treatment as well as other chemical treatments is always given previous to distillation. However, it may sometimes be advisable to blend the acid treated and distilled but unsweetened gasoline with straight run gasoline and then give a "doctor" treat.

In the treatment of cracked distillates it is not advised to add sulphur at any stage after the acid treatment, because sulphur or some of its compounds will remain dissolved in the oil. This is of course especially true if the oil is treated with plumbite solution after distillation as is the practice with straight run distillates.

It may be pointed out, however, that in the case of oil such as cracked distillates from some Mexican oils which cannot be treated by the aforementioned method, that the plumbite treat is given before the acid treat in which case a small amount of sulphur may be added without injurious effects.

It is finally advised for best results from the viewpoint of the product to distill the cracked oil with a low fire in the presence of steam. The preferred practice from the viewpoint of economy is to straight fire up to about 230° F. and introduce steam.

The present work has demonstrated that best results can be obtained with cracked distillates if the following order of treatment is followed. The reasons for such order of treatment and the introduction or omission of various steps will be clearly brought out in the experimental treatments shown below:

(1) For oils which do not contain a considerable amount of sulphur, such as pressure distillates from charging stocks of Mid-Continent origin.

(a) Application of 66° Be. sulphuric acid in several doses.

(b) A thorough washing with water, the greater the number of washes the less the amount of caustic needed in the subsequent step.

(c) Caustic wash followed by water wash.

(d) Distillation with steam, preferably introducing the steam into the body of the oil. The steam distillation may be assisted by a low fire.

The keeping qualities of the resulting gasoline will be improved if the final water wash shown above is followed by a wash with a small amount of sodium plumbite solution, and then a final water wash before steam distillation.

(2) Where the oil contains sulphur compounds, e. g. pressure distillate from charging stocks of Mexican or California origin the above scheme is followed, however making use of a larger amount of sodium plumbite (litharge in caustic soda) as outlined in the general method. This method is the one that can be most generally applied to the treatment of cracked distillates. No sulphur is added, and it is recommended that its use be abolished in treating cracked distillates, except as in under (3). The plumbite is used as in under (1) and since it may be recovered by settling out impurities an excess may be used without loss. The caustic treat may sometimes be omitted when the plumbite treat is given.

(3) In the very few exceptional cases where the above treats fail to give water white gasoline of sweet odor passing all specification tests a heavy plumbite treat is given **previous** to the sulphuric acid treat in which case a very small amount of sulphur is added as a precipitating agent. The distillate is then washed with water, acid treated, washed again with water, and finally steam distilled.

(4) Blending cracked distillates with straight run light distillates increases the ease with which the former may be treated. In some cases it may be advisable, though not as economical as the above methods, to acid treat the cracked distillate, water wash and neutralize, steam distill and then blend with straight run gasoline for sweetening. The cracked distillate, however, may be more economically treated alone or blended with the benzine cut from straight run material and treated, preferably as under (2).

The pressure distillate as such is always treated. It is inadvisable to treat the gasoline from the pressure distillate either with sulphuric acid of sodium plumbite, although a wash with dilute

[15] Mabery and Smith, Amer. Chem. J. 16, 83-89, (1894.)

[16] Dunstan and Brooks, Jour. Ind. Eng. Chem. 14, (12), 1112-15.

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the most part done by reducing kerosene and treating the bottoms for use as absorption oil. A straight cut from the worm, running either continuous or batch, or a back trap from refractionating tower, will not make sufficiently close cut to secure initial as well as gravity. These cuts when made for gravity, show too low initial boiling point, so the required initial is obtained by reducing, just as some lubricating distillates are reduced to secure high flash and fire.

Stock consisting of kerosene distillates, cut over at 45 Be. and out at 37 Be. is reduced in a clean still by distilling off the naphtha and kerosene, thus securing an additional recovery of naphtha as well as producing absorption oil, out of kerosene distillate. Depending upon the crude used and the refinery equipment, this stock may run from a cut at 46 Be. down to a cut at 35 Be., this being best determined in the laboratory at the time the run is being made.

After reducing, the oil is treated with acid in the agitator to remove unsaturations, washed and neutralized, when it is ready for use. While the color should be good, prime or standard white, still, color is not usually required in a specification. Careful running and reducing in a clean still usually secures the proper color.

The absorption plant being comparatively new, apparatus and practice varies widely with the designer and the operator. Some of the keenest talent is directing itself to the design of absorption gasoline plants and manufacture of natural gasoline, testing quality and quantity of gas and laying out plants to best suit the conditions found. Lean and rich gas are both being passed through absorption plants; many compression plants are being changed over to absorption because a better product is secured and the cost of plant per thousand feet of gas treated is less with the absorption plant of size than with the compression plant.

As soon as a field is discovered, contracts for gas are negotiated, so that we may safely say that in the future no casinghead gas capable of producing gasoline will be wasted. As a consequence, the demand for absorption oil increases and this product should be added to those of the refinery.

sodium hydroxide or other alkali may improve its keeping qualities in some cases. The treatment of the gasoline as such entails another distillation and greater losses. Reference to the following table will show that even with such small quantities of acid as 0.05 per cent, cracked gasoline will go off color if not finally distilled even if the acid treat is followed by a water wash and caustic. This, of course, is due to the residual compounds left in solution by the acid treatment.

It is desirable in some cases to subject the pressure distillate to a preliminary water wash or even a wash with dilute alkali especially where water soluble compounds such as hydrogen sulphide are present.

It is strongly recommended that cracked distillates be treated by continuous methods thus cutting down the losses attendant upon evaporation by batch treating methods. It is possible to use batch methods with resulting low losses in a closed agitator making use of a blower system for agitation but the latter method is not as desirable as a continuous system.

By-Product Recovery

Usually the sludge acid from light oil distillates after the treatment with concentrated sulphuric acid is in liquid form. The same applies to the sludges from pressure distillate when concentrated sulphuric acid is used. When fuming sulphuric acid is used with the latter, the sludge becomes very viscous. When these sludges are diluted with water a two layer system is formed. The top layer consists of polymerized and partially sulphonated oil; the bottom layer consisting of the excess sulphuric acid together with sulphonic and alkyl sulphuric acids, or other products of hydrolysis such as the alcohols. When nitrogen is present the nitro-bases are also found in this layer. In some cases a middle layer is formed which contains some of the sulphonated products. When the temperature is slightly raised the sulphonic acids and alkyl sulphuric acids decompose and give still more sulphuric acid.

The diluted acid is concentrated by the usual method of open pan heating as a rule. The dissolved organic matter carbonizes interfering with the operation somewhat by the formation of a surface scum. Partial oxidation with acid of some of the organic matter present results in an evolution of sulphur dioxide during the concentration. It may also result in the loss of considerable acid, especially where high concentration of the latter is reached. It has been found best to dilute several times and concentrate after each dilution.

Blacker and Stanzel[17] have worked out a very good method for the concentration of the sludge acids overcoming the losses of acid, in a great measure due to reduction of the acid, by passing a current of air through the acid while concentration is going on. Since very little suplhur dioxide is formed during this process it is assumed that oxidation takes place either directly or indirectly at the expense of the air. In addition to the recovery of sulphuric acid for the use again in treating, the impure acid is used in the manufacture of fertilizers and other products. The oily lawer which separates out upon dilution has been used for the making of artificial asphalts, rubber substitutes and for fuel.

In the early American practice in the recovery of sulphuric acid from the waste sludges lead pans were used to evaporate the product. The acid was then distilled in glass retorts from a strength of about 60° Be. to 66° Be. The process was one of batch treatment, the finished acid being siphoned off and the retort charged again. Owing to breakage of the glass retorts platinum stills with lead covers were later substituted and these in turn were replaced by cast iron and stills which, of course, are much less expensive.

Skinner[18] has designed a tower concentrator consisting of four towers, one for evaporating weak acids without condensation of the vapors and one for bringing the partly concentrated acid to 66° Be. and two in series connected to the strong concentrator for collecting the fumes. Heat is applied by direct contact of the products of combustion with the acid. The gases are furnished at high temperatures from a fire box attached to the tower at its base avoiding the introduction of finely divided carbon into the acid by the fire gases.

Very little work has been done on the subject of the recovery of soda wastes. It may be pointed out in this connection that the amount of caustic soda necessary to be used in the refining of light distillates is a function of the number of water washes following the acid treat. An experiment has shown that with eight water washes a very good product could be obtained from a pressure distillate of Mid-Continent origin, without the use of any sodium hydroxide. It is not contended, however, that alkali washes can be done away with entirely, but that when no subsequent treatment is necessary, such as for the removal of sulphur compounds, it is possible to reduce the cost of alkali washes by increasing the number of water washes; the question simply reduces itself to the cost balance between the time factor involved in water washing and the cost of alkali.

Experimental Methods

In the experimental method for making the laboratory treats use was made of a separatory funnel of either one, two or three liter capacity. The acid treat was made in doses as shown in the chart below period. The water washes and alkali washes, as well as the plumbite treat, where the latter was made were all carried out in the same separatory funnel. For convenience in presentation of the data a treating chart has been worked up, in order to avoid repitition of method. In each experiment this chart indicates the equivalent in number of pounds of acid per barrel in terms of cc's per liter and gives the other necessary information regarding the method of treat. Following the treating chart are shown the experimental tables with information concerning the starting product and the finished gasoline. Analysis of the starting product was made using a Hempel fractionating column in order to take off the various cuts.

It is to be pointed out as outlined in the discussion of the plant scale treat, that the finished gasoline is in most cases distilled off in the presence of steam for a great many types of cracked distillates. This is an important factor since experiment has shown that the acid treated pressure distillate in most cases would go off color when distilled with straight fire, without the use of steam. As an example of this see table below. There is no doubt in the writers' minds that the chief factor entering here is one of temperature control. The use of steam, according to its partial pressure, enables the gasoline to be distilled at very much lower temperatures. As long as the total pressure exceeds atmospheric pressure, regular distillation will take place, the total pressure being the sum of the partial pressures of the steam and the oil, therefore, the temperature necessary to attain this partial pressure of the oil is lowered and regular distillation takes place at this lowered temperature. The introduction of the steam into the oil body also increases the vaporization surface enormously, and thus brings about a greater rate of distillation than if the steam was simply passed over the surface of the oil.

It is well known that sulphuric acid treated oils contain alkyl sulphuric acids and other compounds which remain dissolved in these oils. There is, therefore, the possibility of decomposition of these compounds at the higher temperatures, as well as the mechanical carrying over of the particles of coloring matter at the higher temperatures. In addition the steam exerts a chemical effect and in practically every case where the oil is treated with sodium plumbite, both lead sulphide and other lead compounds were precipitated in the retort during distillation. Certain information has already been obtained in this laboratory which points to the importance of the distillation under decreased temperatures by imposing reduced pressure upon the system by the use of a vacuum pump. When this work has been expanded upon it will be reported in a later paper.

Interpretation of the "Doctor Test"

Sulphur dissolves very appreciably in a solution of caustic soda either alone

EFFECT OF TREATING FINISHED GASOLINE FROM CRACKED HYDROCARBON OIL WITH SULPHURIC ACID (66° Be.)*

Baume Gravity	50.7	59.7	59.7	59.7	59.7
Specific Gravity	0.738	0.738	0.738	0.738	0.738
Original Color	Water White	Water White	Water White	Water White	Water White
cc's Used	110	110	110	110	110
cc's Recovered	106	106	107	108	108
Color After	Yellow	Light Yellow	Straw	Prime	Dark Water White
Odor Before	Fair	Fair	Fair	Fair	Fair
Odor After	Good	Good	Good	Good	Good
Treating Material		Sulphuric Acid in All Cases.			
Per Cent Used (by wt.)	1.0	0.5	0.3	0.1	0.05
Lbs. of Acid per bbl. gasoline	2.58	1.29	0.86	0.258	0.13
Color after standing 10 days	Dk. Brown	Dk. Brown	Dk. Brown	Dk. Brown	Dk. Brown

*The gasoline was first decolorized by distilling the pressure distillate with 4% by weight of Fuller's Earth.

[17]Blacker and Stanzel, U. S. Pat. 965,276, (1910.)

[18]Skinner, Chem. & Met. 27 (15), 734-6, (1922.)

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TREATING SHEET

Charge 1000 cc.

Quantity of Acid	1 lb. per bbl.	1¼ lb. per bbl.	2 lb. per bbl.	2½ lb. per bbl.	3 lb. per bbl.	3½ lb. per bbl.	4 lb. per bbl.	4½ lb. per bbl.	5 lb. per bbl.	5¼ lb. per bbl.	6 lb. per bbl.	6½ lb. per bbl.	7 lb. per bbl.
c. c. Water (total)	100	100	100	100	100	100	100	100	100	100	100	100	100
No. of Applications	2	2	2	2	2	2	2	2	2	2	2	2	2
Water as above is used when objectionable water soluble substances such as hydrogen sulphide is present.													
cc. Acid (66° Be.) (total)	1.55	2.32	3.10	3.87	4.65	5.42	6.20	6.97	7.75	8.52	9.30	10.7	10.85
No. of Applications	1	1	1	1	2	2	2	2	2	3	3	3	3
c. c. Water (total)	100	100	100	100	100	100	100	100	100	100	100	100	100
No. of Applications	2	2	2	2	2	2	2	2	2	2	2	2	2
c. c. 12° Be. NaOH (total)	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5
No. of Applications	2	2	2	2	2	2	2	2	2	2	2	2	2
c. c. Water	50	50	50	50	50	50	50	50	50	50	50	50	50
c. c. Na_2PbO_2 (30° Be.) (Litharge dissolved in 12 to 30° Be. caustic soda. Use from 0.5 to 10% by volume depending on sulphur content and nature of oil.													
c. c. Water (When plumbite is used)	50	50	50	50	50	50	50	50	50	50	50	50	50

12° Be.
11.5 cc of 12 Be. NaOH—50 gals. per 100 bbls.
N. B. This quantity is in excess of that used in practice, but was made use of to expedite the work and save time.

	Time allowed for Agitation	Time allowed for Settling
Water	10 min.	10 min.
Acid	20 min.	20 min.
Alkali	15 min.	15 min.
Na_2PbO_2	10 min.	10 min.

or when the solution is saturated with litharge. When sulphur is allowed to remain in such a solution for several days a concentrated solution of sodium sulphide is formed. The lead as indicated above is precipitated as lead sulphide. The charge upon the lead whether as litharge, sodium plumbite or lead sulphide, is two positives. No change is therefore entailed with respect to lead. Tests for sulphate ion showed the presence of the latter, which indicated that sulphur with zero charges is reduced to sulphur with two negative charges, namely as the sulphide ion and oxidized to sulphur with six positive charges as the sulphate ion. Hence, we have a case of auto-oxidation and reduction somewhat as follows:

$$4S^{0} = 3S^{--} + S^{(6+)}$$

The mutual effect of sodium plumbite and sulphur upon one another brings into question the interpretation of the doctor test, which under any circumstances has the time factor involved. The hypothetical action between sodium plumbite and sulphur may possibly be stated as follows:

$$2Na2PbO_2 + 4S^{0} \rightarrow Na_2S + Na2SO_4 + PbS.$$

The precipitation of lead sulphide as an index of a positive doctor test is thus to be interpreted cautiously especially if the test bottle has been allowed to stand for some time.

It can be seen from the above that the actual amount of litharge required per barrel of pressure distillate treated depends more on the nature of the sulphur compounds than upon the actual percentage of sulphur present. This is especially true of cracked distillates.

It is to be particularly called to the attention of the reader that the absence of sulphur or its compounds is not a prime requisite for an oil showing a negative test with doctor solution. As a matter of fact, only those compounds which react with this solution are removed so that it is natural to expect a negative test after such treatment.

The use of sodium plumbite solutions as previously prescribed in the treatment of cracked distillates is, however, to be particularly recommended even when sulphur is present only in small amounts as it has been found to improve the keeping quality of such distillates.

Possible Mechanism of the Sodium Plumbite and Sulphur Reaction in Refining

With regard to the alkali sulphides the following reactions may be pointed out: sodium hydrogen sulphide is formed on saturated sodium hydroxide

CRACKED DISTILLATE FROM CUSHING GAS OIL

Acid Treated and Straight Fire Distilled

Lbs. of Sulphuric Acid per bbl. of Pressure Distillate	Be. Gr. Acid	Per Cent Gasoline	Be. Gr.	Gasoline High Temp. Reached	Color
10	66°	50.7	56.4	415°F.	Deep Yellow
8	66	50.0	56.4	410	Deep Yellow
6	66	50.0	57.6	410	Light Yellow
5	66	50.7	57.3	410	Light Yellow
4	66	50.9	57.0	410	Yellow
3	66	50.8	57.1	410	Yellow

CHARGING STOCK

	Cushing Gas Oil	Mid-Cont. Gas Oil	Mid-Cont. Kero. Dist.	Calif. Gas Oil	Mid-Cont. Fuel Oil	Mid-Cont. Topped Crude	La. Fuel Oil	La. Topped Crude	Ranger Topped Crude	Burkburnett Fuel Oil	Healdton Crude Oil	Tarakan Borneo Crude	Fremont Crude Wyo.	Mex. Gas Oil	Gas Oil Mexican Crude	Mex. Crude Dist.	Ill.-Ky. Fuel Oil
Baume Gravity	34.4	35.4	38.4	27.6	27.0	26.6	26.9	28.9	26.8	23.2	29.6	18.2	23.3	26.2	21.0	26.3	23.7
Sulphur Percent	*	*	*	*	*	*	*	*	*	*	*	*	2.8	3.10	3.40	2.35	0.40
Coke Percent (100 cc Engler) (Dist.)	0.2	Trace	Trace	Trace	3.2	2.8	3.8	3.8	3.36	5.3	3.1	2.7	7.7	1.0	2.0	3.4	7.4

CRACKED DISTILLATE OIL FROM CRACKING OF ABOVE CHARGING

Stock at 120 Pounds

Baume Gravity	47.8	48.7	47.3	36.5	46.9	52.8	54.0	53.6	53.9	52.8	48.7	37.8	53.0	41.9	46.4	53.0	55.1
Color	Brownish Yellow	Deep Yel'w	Lemon Yellow	Dark Brown	Brownish Yellow	Lt. Yel'w	Lt. Yellow	Lt. Yel'w	Lt. Yel'w	Brownish Yel'w	Yellow	Yellow	Pink	Deep Yellow	Yellow	Deep Yellow	Yellow
Gasoline																	
Percent	50.0	55.0	58.0	37.6	47.5	74.5	71.7	69.3	69.5	75.5	69.2	49.6	83.6	42.0	57.7	68.5	69.3
Baume Gravity	57.9	56.0	54.0	48.4	56.0	54.6	56.2	56.9	57.4	55.6	52.7	49.1	54.4	52.7	53.2	58.0	58.7
Initial B. P. °F.	122	111	120	160	118	112	121	122	118	116	126	108	120	128	107	106	110
End Point °F.	422	438	438	437	437	437	438	436	436	437	437	437	437	434	413	422	407

TREATED CRACKED DISTILLATE

Pounds per bbl. 66° B. Acid (Sp. Gr. 1.84)	4.0	1.5	4.0	6.0	3.5	4.0	4.0	4.0	3.5	3.5	3.5	5.0	6.0	6.5	7.0	7.0	4.0
Charge (cc.)	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	2000	1000	1000	1000
Recovery (percent)	98.0	98.5	98.0	97.0	97.5	98.0	98.0	98.0	98.0	97.5	98.0	97.5	98.0	97.5	98.0	97.5	97.5
Treating Loss (P'ct)	2.0	1.5	2.0	3.0	2.5	2.0	2.0	2.0	2.0	2.5	2.0	2.5	2.0	2.5	2.0	2.5	2.5
Baume Gravity	46.7	49.5	46.0	35.8	46.2	51.8	52.8	52.5	52.9	51.8	47.9	36.2	52.2	40.9	45.8	52.1	53.8
Color	Yel'w	Amber	Yel'w	Brown	Very Deep Yel'w	Lt. Yel'w	Lt. Yel'w	Lt. Yel'w	Lt. Yel'w	Deep Yel'w	Lt. Yel'w	Lt. Yel'w	Pink	Deep Yel'w	Lt. Yel'w	Brownish Yel'w	Deep Yel'w
Gasoline																	
How distilled	All of the Above Treated Cracked Distillates Distilled with a low Fire in the Presence of Steam. Distill Off up to 230°F. with Straight Fire																
Percent Over	50.0	54.5	58.0	38.5	46.0	74.6	72.0	69.5	69.5	74.5	69.0	49.5	83.5	43.0	57.7	68.5	69.5
Baume Gravity	57.8	56.1	53.8	49.5	56.3	54.0	55.9	56.7	57.2	56.2	52.5	49.0	54.2	52.8	53.1	58.0	58.5
Color Universal Saybolt Chronometer	25	24	24	23	25+	+25	+25	+25	+25	24	+25	23	+25	25	24	23	+25
Doctor Test	All Gasolines from Treated Cracked Distillate Listed Above Showed a Negative Test.																
Corrosion Test	All Gasolines from Treated Cracked Distillate Listed Above Showed a Negative Test.																

Remarks: (a) * Indicates a percentage of sulphur from 0.0 to 1.0. Cracked distillate from these charging stocks treated with sodium plumbite (litharge dissolved in caustic soda solution) and water washed immediately preceding distillation. No sulphur used as a precipitating agent.

(b) Cracked distillates from charging stocks without star (*) in column were given a comparatively heavy plumbite treat previous to acid treat. Very small quantity of sulphur used as a precipitating agent. Plumbite treat followed by water wash.

(c) Blank determinations made on the above cracked distillates indicate that the average mechanical loss owing to the experimental method used is about 0.8%. This can be subtracted from the treating losses indicated above to give the solution loss.

with hydrogen sulphide. When the hydroxide and hydrogen sulphide are present in equivalent proportions sodium sulphide is formed. Alkali sulphides hydrolyze and the solution formed, quickly oxidizes on exposure to the air, and sulphur is liberated. The latter is dissolved by the alkali sulphides forming polysulphides which can be further oxidized to thiosulphates and sulphates.

The question arises whether similar reactions would go on between sodium hydroxide and compounds having an alkyl group instead of hydrogen, i. e., whether upon replacing one or two of the hydrogen atoms of hydrogen sulphide molecule to give thio-alcohol or alkyl sulphides these compounds react with the litharge dissolved in sodium hydroxide and what conditions would favor this reaction.

It has been found that litharge in sodium hydroxide will turn practically colorless cracked hydrocarbon oils with a high sulphur content yellow to orange color, indicating a reaction. Experiment shows that sulphur is appreciably soluble in hydrocarbon oils including the cracked hydrocarbons. This brings up also the possibility of the formation of alkyl polysulphides analagous to the alkali polysulphides. The present research has shown that formation of a lead compound soluble in the cracked distillate, when sodium plumbite solutions are shaken or agitated with such oils. This compound is formed upon standing after treating the cracked distillate with a solution of litharge in sodium hydroxide, drawing off the latter and washing with water. Altho, the presence of sulphur compounds in the pressure distillate favors the formation of this lead compound it contains no appreciable amount of sulphur. When purified it is light yellow to white in color and contains about 80 per cent of lead. Further work is in progress regarding this compound which will be reported upon later.

We then have the possibility of all reactions taking place between substances dissolved in the same medium namely the oils. The problem therefore seems to be very much more complex than what has hitherto been supposed. The chief explanation of the action of sulphur in causing a coagulation and precipitation of lead sulphide from the oil when used in conjunction with sodium plumbite has been that the sulphur acts catalytically in the process. Others claim that the reaction is wholly colloidal in nature, the sulphur simply acting as a coagulating agent. For purposes of the present study the latter explanation is only incidental, because when the cracked oil is freed from all of the products of the various treating processes no precipitation occurs until the addition of the sulphur.

It is not, however, contended that the excess sulphur does not act as a coagulating agent after precipitation has occurred. Regarding the first explanation namely on a catalytic basis it may be said that this explanation does not find favor with the present writers, if for no other reason than the fact that such an explanation is generally used to cover up the lack of material resulting from investigations into the subject. The possibilities are manifold especially from the viewpoint that we have, as shown above, all of the reactants dissolved in the same medium, and further work is in progress in this laboratory upon the subject.

Discussion and Results

It will be seen from the preceding experimental tables that it is possible by the methods used here with each type of cracked distillate used, to obtain a water white gasoline (21 Saybolt Universal Chromometer or better). All of these gasolines were sweet in odor and passed the corrosion tests as well as the doctor test.

Reference has been made in a previous section to the use of sulphur in conjunction with the plumbite treat and it has been advocated in this work that the use of sulphur be done away with except in unusual cases. Under these circumstances the plumbite treat is applied previous to the acid treat. Experiment in this laboratory has shown that where the sulphur is used in conjunction with the plumbite treat immediately before or after distillation, that some sulphur remains in the treated oils. It may be mentioned here that various substitutes have been found in this laboratory for sulphur as a precipitating agent, where required. These will be referred to in a later communication.

No quantitative measurements have as yet been made upon the solubility of sulphur in cracked. distillates. However, qualitative tests show an appreciable solubility; evaporation of the oil leaving the sulphur in a crystalline form of the monoclinic and othorombic forms.

At slightly elevated temperatures sulphur will combine with hydrocarbons both of high and low molecular weight forming hydrogen sulphide and

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organic derivatives of sulphur. Above 250° F. sulphur is distilled over in the free state and the gasoline thus distilled over redissolves the deposited sulphur.

Guislin[19] finds that sulphur is fairly soluble in petroleum at low temperatures, about 1.5 per cent in a light distillate. It is more soluble in the heavier oils and increases with rising temperature. On cooling sulphur crystallizes out. On heating sulphur acts upon organic impurities and forms some hydrogen sulphide and water and organic compounds which remain dissolved.

Friedmann [20] on heating hexylene and sulphur together obtained $C_6H_{12}S$, $(C_6H_{12})_2S$, and $C_{18}H_{34}S_2$. The residue left on distilling the products of the reaction was $C_{24}H_{46}S_3$ and an asphaltic product of the composition $C_{24}H_{26}S_2$. With octylene he obtained a similar set of compounds. With hexadecylene and sulphur he obtained a compound $C_{16}H_{32}S$ with an asphalt residue.

The question of the necessity of distilling cracked distillates in the presence of steam is one that deserves attention. As stated previously the question is namely one of reduction in temperature owing to the partial pressure of the steam. Although in practice cracked distillates from some Mid-Continent charging stocks may be distilled with straight fire and a full yield of water white gasoline recovered, there are a great many cracked distillates, especially of California and Mexican origin which cannot be so distilled. The problem reduces itself to an economic one in the saving of steam and work with respect to its solution is at present in porgress in this laboratory.

It is to be pointed out here that distillation losses on cracked distillates are relatively high and it is strongly urged and recommended that a vapor recovery system be installed on all rerun stills. Such recovery systems may be of the compresion, absorption or adsorption type.

In conclusion the reader's attention is called to the bibliography on refining methods and recovery of waste products following the references.

[19]Guislin, Pet. Rev. 28, 486.
[20]Friedmann, Petroleum II, 693-7, (1916.)

Summary and Conclusions

1. The effect of sulphuric acid upon cracked hydrocarbon oils from the viewpoint of refining has been studied.

2. Quantitative relationships with regard to refining cracked hydrocarbon oils have been worked out.

3. Treating cracked hydrocarbon oils from a mechanical viewpoint has been discussed.

4. A complete system of treating cracked hydrocarbon oils form charging stocks of various sources to produce commercial gasolines has been presented.

5. Recovery of waste treating products has been discussed.

6. A mechanism for the action of the co-called "Doctor Treat" has been postulated.

7. Some problems of the future in refining cracked hydrocarbon oils have been discussed.

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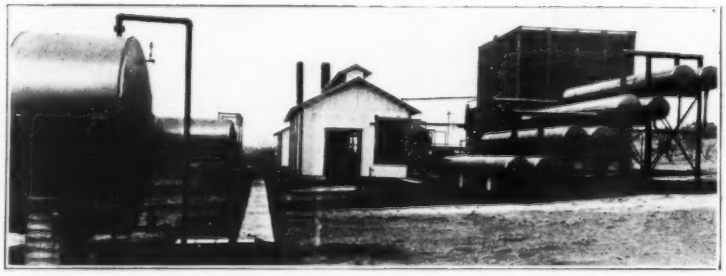

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Tulsa, Okla.—Plans now are under way for the holding of a meeting of the Western Petroleum Refiners Association in Tulsa at the time of the International Petroleum Exposition to be staged here the week of October 8 to 15. George N. Moore of Chicago, president of the association, has the matter under consideration.

W. P. R. A. Plans to Meet With Exposition at Tulsa

Wichita, Kan.—The growth of the Western Iron and Foundry Company here from a $15,000 concern in 1902 to an enterprising company occupying a $300,000 plant in 1923 reflects the successful management of the corporation which is engaged in the manufacturing of refinery equipment and other supplies for the oil industry as well as for other industrial interests.

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Since the Hearne plant will not be located on the I. & G. N. railroad, Humble proposes to build two 4-inch and one 6-inch pipe lines from the refinery to a loading rack along the I. & G. N. railroad near the town of Hearne, and the buyer can then distribute the fuel over its own system.

Tulsa, Okla.—U. S. Cities Corporation and Lorraine Petroleum Company expect to start operations at the refinery of the Continental Refining Company at Bristow in this state and will run on crude from U. S. Cities property in Creek County which will be connected with the plant by a three inch line.

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I have received your subscription blank for The Refiner and Natural Gasoline Manufacturer, and am enclosing postoffice money order for the amount of $4, covering subscription of four copies for same.

I received the sample copy some few days ago, and wish to say that I believe this magazine is going to fill a long felt want among oil refiners.

The experience I have had is that on innumerable occasions fellow employees have asked me if there was not a plain intelligent, comprehensive publication on refining processes, and I have never been able to reply in the affirmative. I therefore see no reason why your paper should not have a large list of subscribers among the employees of refineries.

Your article entitled "The Use of Sulphuric Acid In Oil Treatment" was especially interesting to me, and intelligently written. However, it gets my goat to read an article of this kind and then not have the pleasure of seeing the author's name.

Wishing you unusual success, I am,

Yours very truly,
J. E. LENHARDT.

Cholly: "You know, last year the doctor told me if I didn't stop smoking I'd be feeble-minded."

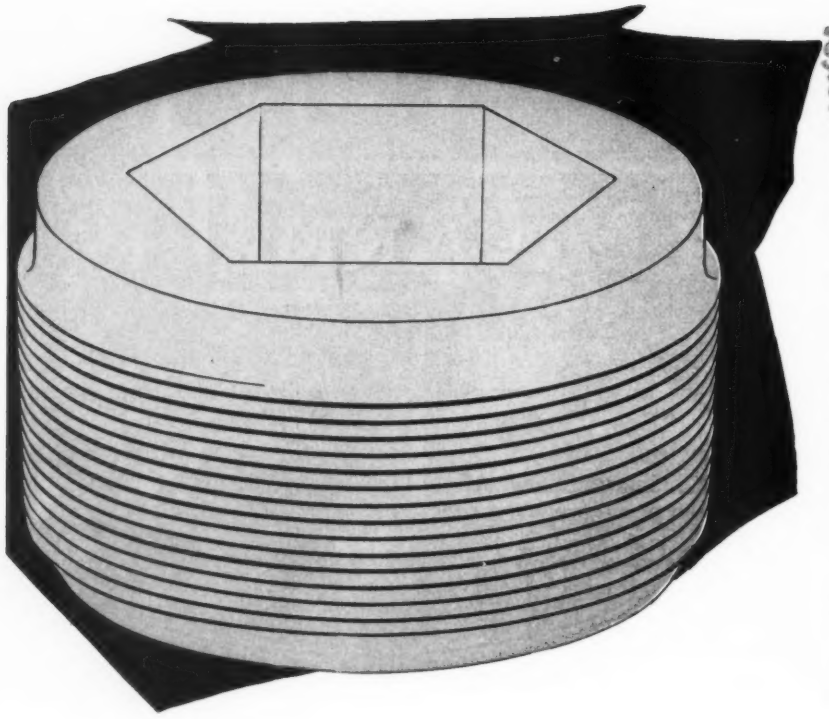
Grace: "Why didn't you stop.'"—Gulf Club Banner.

HILLS-McCANNA NO. 45

A BRONZE WITH THE STRENGTH OF STEEL

A Metal Peculiarly Qualified for use in Oil Industry

Acid Resisting
Non-Corrosive
Non-Pitting
Non-Porous



Features of HILLS-McCANNA No. 45

The physical properties of this render it acid-resisting, non-corros pitting, and non-porous. In additio above, this metal has a co-efficien pansion 50% greater than steel bronze, with the strength of steel.

Owing to the fact that certain action derogatory to most metal countered in the oil industry, this proves a boon to those concerns en oil production, refining, etc.

Hills-McCanna Still Plug

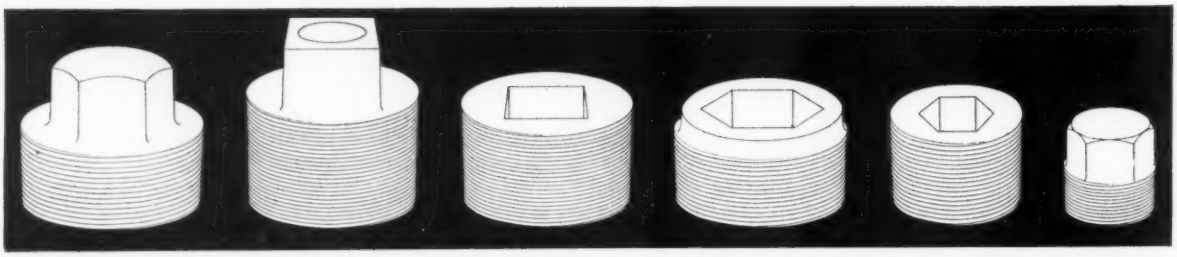
This plug will not corrode, become pitted, or porous, through the ever present chemical action so destructive to other metals. The Hills-McCanna still plug being made of our No. 45, (a metal elsewhere explained), will not "freeze in" or damage in any way the header or return bends upon removing the plugs after a run.

The above feature is due to the fact that this material has a co-efficient of expansion 50% greater than steel.

This plug, when screwed into the recess, forms a free and comparatively loose-fitting closure, which under heat, expands, making an absolutely tight leak-proof closure. On cooling down, the plug contracts, making it easily removable.

The Hills-McCanna still plug is supplanting all other types of still plugs in this field, and is standard equipment in Dubbs Plants, Sinclair Refining, and many other refineries using pressure stills, or what is known as the "Cracking Process."

We can supply any type of closure in this metal. Tell us your requirements.



HILLS-McCANNA CO.

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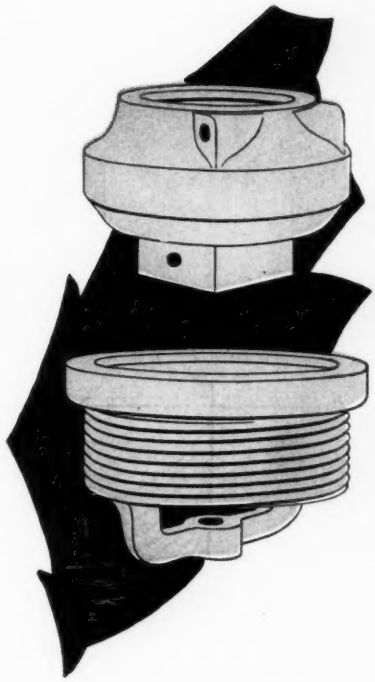
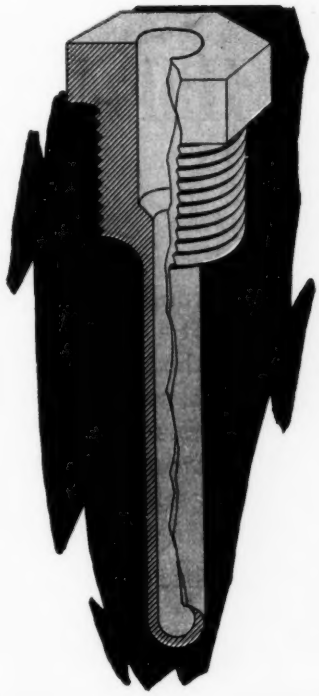
Hills-McCanna Valve Stems and Seats



Being made of Hills-McCanna No. 45, our valve stems and seats are non-corrosive, non-pitting, and acid-resisting. They give long continuous service without replacement. Hills-McCanna valve stems and seats may be had in any size and shape desired. Send specific information, detailed drawing, or pattern, when ordering.

Hills-McCanna Thermometer Wells

Eliminate the lag



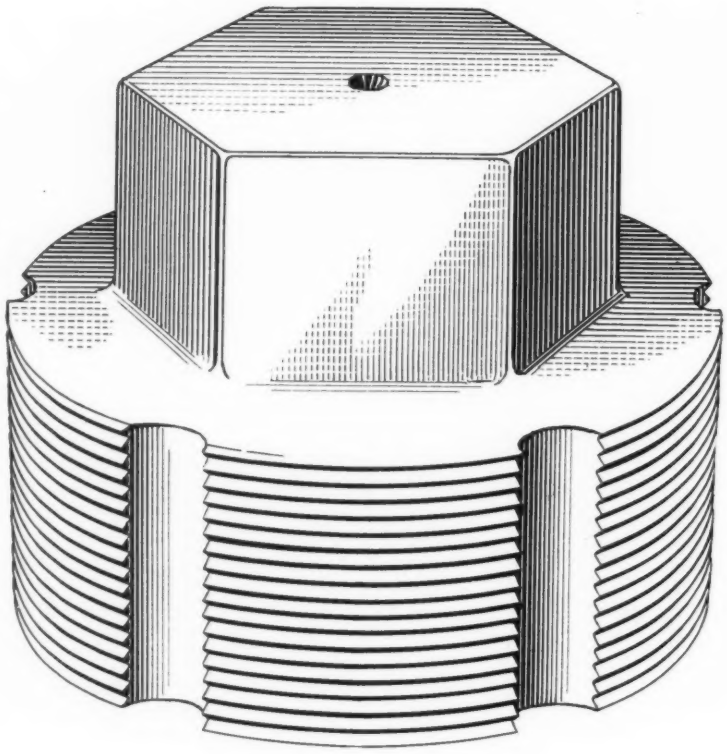
The thermal-conductivity of the Hills-McCanna thermometer well is nearly six times greater than the steel well. The result is quick and accurate reading at all times.

Because of the non-corrosive feature of our No. 45 alloy, these wells are easily removable without damage to the tubes or well itself. Hills-McCanna wells have the added advantage of being non-pitting, non-porous, and acid-resisting.

The installation of Hills-McCanna thermometer wells in your plant will immediately eliminate a great many of your present unsatisfactory conditions. Large wells may be made of this material in the single piece, consequently they are more satisfactory than where the well is a built up unit with several joints.

Made in any size to order. Send detailed information.

2025 Elston Avenue
CHICAGO



Hills-McCanna Clean-Out Plug or Pipe Tap

For cleaning threads in headers or return bends, after the run, the Hills-McCanna clean-out plug is an indispensable tool. It assures a clean thread, and eliminates the danger of damaging the threads on the plugs when replacing. Many oil refineries have experienced costly delays and damage through lack of a tool of this kind. The saving of time in replacing closures is so great where this tool is used, that its cost is ridiculously low by comparison.

Made of high-grade, hardened tool steel. When ordering state size of plug and thread.

HILLS-McCANNA CO.

2025 Elston Avenue
CHICAGO

PERSONNEL OF THE INDUSTRY

W. B. HAMILTON
President of the Texhoma Oil and Refining Company of Wichita Falls, Texas

A. F. Hickey, sales manager of the Taxman Refining Company, has returned to Chicago after a business tour through the states of Ohio, Indiana and Michigan.

George D. Locke, formerly of the Barnsdall Refining Company, was in New York the first part of July in connection with the export business of Barnsdall.

Horace G. James, former secretary of the Western Petroleum Refiners Association and now president of the Missouri Oil Men's Association, has become sales manager of Derby Oil and Refining Company with offices at Wichita, Kansas.

Joe Mudd, Chicago representative of the Marland Refining Company, has just completed a tour of the northern territory in the interest of company business.

J. S. Cosden, president of Cosden and Company, is away from his New York offices on a business trip to the Southwest, where he will confer with company officials at Tulsa, Oklahoma, and other points.

Captain Paul J. Blackman, vice president of the New England Fuel Oil Company, and other Magnolia subsidiaries in Mexico, returned to Tampico from a trip to Texas.

S. E. Murphy, sales manager of the Empire Refineries, Inc., is on a business trip through the east.

F. E. Capen, superintendent of The Texas Company's refinery at Casper, Wyoming, was in Houston recently at the company's main office.

W. R. Spann, president and general manager of the Montrose Oil Refining Company, has resigned to become president of the National Gasoline Company, with offices at Fort Worth, Tex.

James M. Curran, recently with the Midland Refining Company at Kansas City, is now with the Skelly Oil Company at Tulsa.

S. M. Morian has resigned as manager of the Casper division of the Utah Oil and Refining Company to enter business for himself. B. W. Musser will take his place.

J. R. Shoup and H. L. Hileman, representing the Joseph Reid Gas Engine Company of Oil City, Pennsylvania, stopped in Houston on their visit to the Gulf Coast region. They have recently completed a trip through the California and Rocky Mountain fields.

E. B. Reeser, vice president of the Barnsdall Refining Company, returned to the New York offices after spending several days at the offices in Tulsa.

J. W. O'Donnell, president of the O'Donnell refinery, has left on a business trip to Mexico to investigate oil possibilities there.

Fred W. Cambell, chemical engineer for the Sterling Oil and Refining Company of Wichita, has resigned to become refinery superintendent for the Industrial Refining Company at El Dorado, Kansas.

F. E. Richardson of the Producers and Refiners Corporation, has been placed in charge of the natural gasoline department in the Wyoming area.

Walter Herr, formerly connected with the Union Petroleum Company at Chicago, has joined the sales force of the Taxman Refining Company.

F. L. Sheller of the Paragon Refining Company of Toledo, Ohio, is in Lexington, Kentucky, for the company.

Norval White, West Coast representative of the American Petroleum Institute, was in Los Angeles lately on one of his regular visits.

E. O. Mullin, sales representative for Dean E. Foster, manufacturer of the Foster Baffle for gasoline plants, is making a business trip to Missouri, Colorado, Wyoming, Montana, Texas and California. He will be gone about six weeks.

General American Tank Car Corporation announces the opening of an office at 502 Cosden Building in Tulsa, Oklahoma, with Robert Rose, formerly connected with the Standard Tank Car Company, in charge.

Henry G. Blaine, manager of the fuel department of the Johnson Oil Refining Company, is away from his office in Chicago on a two weeks' vacation outing in Pennsylvania.

L. N. Oppenheimer, who has been connected with the Sapulpa Refining Company in its Tulsa, Oklahoma, offices for the last seven years, five years of which he has been vice president and general manager, has resigned his position. He has made no announcement as to the future.

W. B. Hamilton, president of the Texhoma Oil and Refining Company of Wichita Falls, Texas, is reported recuperating in a sanitarium at Battle Creek, Michigan, following an attack of appendicitis while on a business trip to New York City.

A. W. Deacon, vice president of the St. Louis Surfacer and Paint Company, is on a business trip to the oil fields of California.

E. S. Dwyer, formerly of the Pittsburgh office of the Transcontinental Oil Company, is in charge of refinery sales in Chicago.

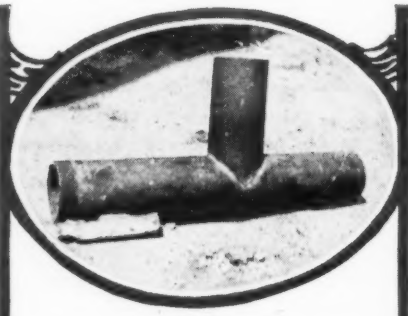
Dean E. Foster, consulting engineer and manufacturer of the Foster Baffle for absorption gasoline plants, has returned to Tulsa from a trip to Breckenridge, Ranger, Eastland, Fort Worth and Dallas, where he has been studying the natural gasoline producing situation.

Constant R. Cloquet, manager of the Compagnie Generale Anversoise, a Belgian oil company, sailed for Europe on the S. S. Belgenland, July 10. He was over here making connections with American refiners to obtain goods for export.

A. L. Johnson, president of the Pulaski Oil Company, has completed arrangements for the enlargement of the company's plant at Pulaski.

W. A. Eddy, president of the Mid-Continent Producers and Refiners Corporation, has announced that the general offices have been moved to 617 Hanna Building, Cleveland. The company is also building 11 service stations in Cleveland.

NEW EQUIPMENT, CATALOGS, BULLETINS, BOOKS



Left—Marking pipe to be cut
Top Center—The joint ready for welding
Right—Marking end of pipe to be welded
Lower Center—The marking ring

Makes Pipe Cut for Angle Welding an Easy Problem

Through the use of wire rings, designed for the purpose, the problem of cuttting pipe for right angle welded joints has been made a simple process.

The ring devices now being used by welding crews through the Mid-Continent field are the result of calculations made by Henry Miller of the Skelly Oil Company.

The use of wire rings requires one for each size of pipe. They can be used only for cutting in welding right angle joints. The process is one so simple that welders grasp it from one demonstration.

The wire rings are oval shaped, made to fit the pipe at the proper angle for cutting. At the point where the welded joint is wanted, the wire ring is placed, the notch on the side of the ring being at the exact point of the center of the joint. The pipe is then marked along the ring.

The ring is then shifted the other way, its exact position being determined by keeping the notch point at which the previous marking was done. When marked in the second position, the part of the pipe to be cut out for the joint is contained within the two sets of converging lines. This part of the pipe is then removed with a cutting torch.

This process is then repeated on the pipe to be welded into the opening, except that the marking is done at the end of this piece of pipe. When this piece is cut off with the torch, the pipe end can be inserted in the opening cut in the other pipe.

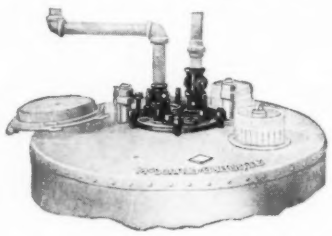
The two pieces of the pipe are then ready for the welder.

The ring measuring devices are an unpatented product, as the basic patent has been issued on another product. The rings are being sold by the Tulsa Oxy-Hydro Company of Tulsa.

Universal Gastite Tank Car Dome Cover Approved

The Tank Car Committee of the American Railway Association has officially approved the Universal Gastite dome cover (permanent type), a device now being introduced by the A. Y. McDonald Manufacturing Company of Dubuque, Iowa, for the prevention of evaporation during the loading of gasoline into tank cars.

The cover is being offered in two types. The temporary cover, for attaching to dome of car only while the gasoline is being loaded, is made of aluminum so as to be sufficiently light for one man to handle. The permanent cover is made of cast iron, is either bolted or screwed to flange of dome, and is provided with a cast iron top for protection during transit.



When loading with this cover a pressure valve, set at two to five pounds, is placed on vent outlet of the gas-tight cover, thus eliminating the greater proportion of gassing which takes place in a tank car loaded in the ordinary way; or gases are carried back to storage, via the vent outlet, where they are absorbed.

It practically eliminates the fire hazard due to escaping liquid and vapor during the loading of gasoline, according to the company.

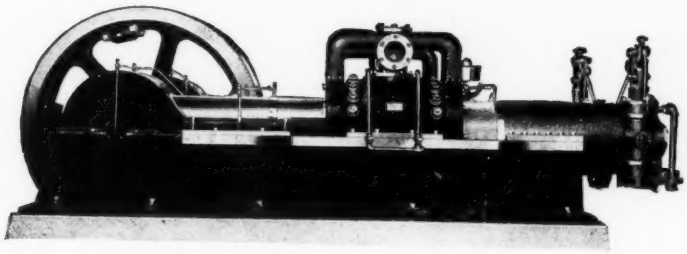
Skelly Closes Contract For 32,000 Gallons Gas

Tulsa, Okla.—The Skelly Oil Company has closed a contract with the Standard of New Jersey calling for the delivery of approximately 32,000 gallons of gasoline daily over a period of one year at a price representing a percentage of the tank wagon market. This contract will absorb about one-half the total Skelly output at the present capacity of that company.

The Association of Natural Gasoline Manufacturers has retained G. A. Prevost of Washington, D. C., to investigate patents under which natural gasoline plants are operating in order that a clear understanding may be had of every patent affecting the operating of these plants.

R. A. Broomfield, vice president of the Barnsdall Refining Company, left Tulsa, where he had been spending a few days, for Wyoming and Montana, to take charge of the Barnsdall interests in that area.

THE NEW ENCLOSED TYPE



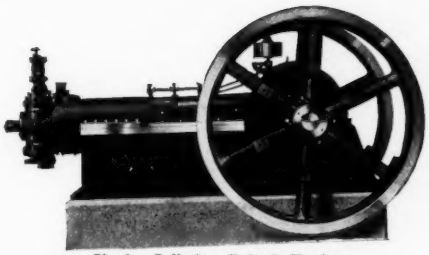
Direct Gas Engine Driven Vacuum Pump, Two Cylinder

Watts-Miller Gas Engines and Direct Gas Engine Driven Compressors and Vacuum Pumps

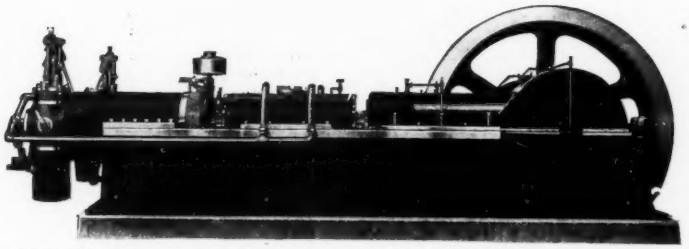
Pat. June 22, 1897; Oct. 6, 1914; April 13, 1915

High Efficiency Gas Engines, Compressors, and Vacuum Pumps for Power Plant Equipment

Sizes from 25 to 400 h. p.



Single Cylinder Belted Engine



Direct Gas Engine Driven Compressor, Two Cylinder, Single or Two Stage

Compressors particularly adapted to casing-head gasoline plants, gas pumping plants, and compressed air installations, in single and 2-stage machines to operate on practically all intake and discharge pressures. Continuous circulating filtering automatic oiling system.

The Miller Improved Gas Engine Co.

SPRINGFIELD, OHIO

DISTRIBUTORS

The Miller Improved Gas Engine Co.
742 Kennedy Bldg.
Tulsa, Okla.

FRICK-REID SUPPLY CO.
Casper,
Wyoming.

Service Department and Warehouse, 323 North Cheyenne St., Tulsa.

RECENT REFINERY PATENTS ISSUED

BY STAFF REPRESENTATIVE

Washington, D. C.—The following patents of interest to the oil refining industry have recently been issued by the patent office at Washington:

No. 1,458,291, issued on June 12, to Ford W. Harris, assignor to Petroleum Rectifying Company, a corporation of California. It comprises an apparatus for dehydrating petroleum emulsion comprising a tank, a pipe by which an emulsion composed of petroleum and water may be introduced into said tank, a lower electrode secured near the bottom of said tank, an upper electrode insulated from said tank and secured near said lower electrode under the surface of said emulsion, and means for subjecting any current flowing between said electrodes through said emulsion to the action of a coercive magnetic field.

No. 1,458,443, issued on June 12 to Alfred Schwarz, assignor to Petroleum Sand Products Corporation, a corporation of Delaware. This is a process of synthetically producing hydrocarbon compounds which comprises maintaining substantially chemically constant solution of hydrocarbons so proportioned that the hydrogen is in excess and varying the temperature while distilling under violent agitation sufficient to form a vapor-oil emulsion.

No. 1,458,983, issued on June 19 to William K. Kirby of Golden, Colo., on a process and apparatus for treating oil shales. This includes the steps of causing a properly proportioned charge of finely divided oil shale and an entraining high boiling point oil to flow in a stream of restricted cross sectional area through an analogously restricted retorting zone, supplying heat to said retorting zone of an intensity to liberate the desired values of said shale in the form of oily vapors, and subsequently liquefying said vapors as separated from said shale.

No. 1,459,156, issued on June 19 to Norman Victor Sydney Knibbs of London, England. It is on a process of distilling and cracking mineral oils and other hydrocarbon containing materials, which consists in causing the material to be distilled or cracked to descend in a finely divided state through an unobstructed chamber in direct contact with a current of hot gas produced by the combustion of the less volatile residues obtained in the treatment of the material.

No. 1,459,515, issued on an apparatus for cracking oils, to William B. D. Penniman of Baltimore, Md., on June 19. It consists of an apparatus for cracking oils under pressure, comprising a closed container for the oil, means for heating the same, a condenser, means for leading the gas and vapor from the heated oil to the condenser, means in the form of a stem coil for bringing the gases and vapors as they pass from the container to a uniform predetermined temperature, means for supplying steam, and thermostatic means actuated in correspondence to the variations in temperature of the gases which have been in heat exchanging relation with the coil to control the passage of steam to the coil.

Shreveport, La.—Recent acquisition by the Louisiana Oil Refining Corporation of the refinery and property of the Louisiana Petroleum Production Company will mean that the plant either will be remodeled, or more likely, razed and rebuilt.

London, England—(By Mail) A report is current here that Sinclair is negotiating with Agwi Petroleum Corporation, Ltd., to supply crude to the company's refinery near Southampton.

Omaha, Neb. — Announcement is made that the Omaha Refining Company with plant at East Omaha is installing a Cross cracking unit with 1,000 barrels capacity. The refinery has been operating on crude from the Salt Creek field.

Wichita, Kans.—Satisfactory results are reported by the Derby Oil and Refining Company in the operation of its two new Dubbs cracking process stills which have been started up at its new refinery in North Wichita.

North American Service to Shippers

Three Repair Shops

Conveniently located at Coffeyville, Tulsa, and Chicago, these fully equipped repair shops give shippers the opportunity to keep tank cars in top-notch condition without unnecessary loss of service.

Storage of Loaded Cars

At Blue Island, Illinois, (within Chicago Switching District) adequate facilities for storing loaded cars awaiting reconsignment.

Bulk Storage

39,000 barrel bulk storage at Clearing, Illinois,—5,000 barrel bulk storage at Blue Island, Illinois—and 165,000 barrel bulk storage at Tulsa. Ready to receive liquid petroleum products under North American Oil Terminal Warehouse conditions.

Let Us Send You Further Details.

LESSORS OF TANK CARS

North American Car Company

327 S. LaSalle St., Chicago

Car Works:
Chicago
Coffeyville, Kans.
West Tulsa, Okla.

Southwestern District Office
Petroleum Bldg.,
Tulsa.

(Courtesy of Conley Tank Car Company)

PAINTS
For Every Purpose

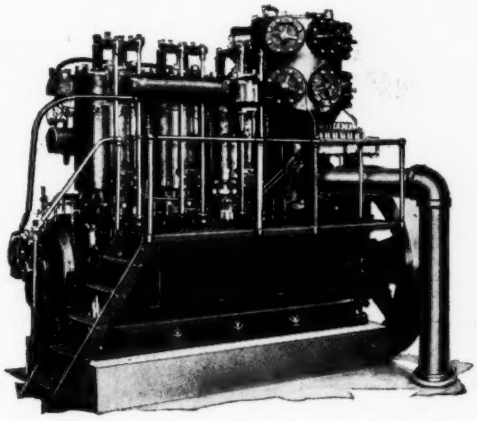
We specialize in Refinery, Tank and Tank Car paints of all kinds.

Your inquiries and orders will receive prompt and courteous attention.

AMERICAN PAINT & SUPPLY CO.
Manufacturers of Paints

Factory and Office—DALLAS, TEXAS

REEVES
VERTICAL
Self-Contained
Gas Engine Driven
Compressor Unit
Sizes up to 300 H. P.



Single Or Two Stage Compressor Cylinder

MAXIMUM EFFICIENCY

MINIMUM SPACE

PROVEN RELIABILITY

FOR FULL DATA WRITE OR WIRE

Consulting and Contracting Engineers in Natural Gas and Oil.

HOPE ENGINEERING & SUPPLY CO.
Mt. Vernon, Ohio, U.S.A.

Branches Pittsburgh, Penna. Tulsa, Okla. Casper, Wyo

Rule for Computing Royalty on Osage Natural Gasoline Unfair Say Manufacturers

Tulsa, Oklahoma.—At a meeting of the Osage Oil and Gas Lessees Association, held in this city June 29, the following resolution, proposed by the investigating committee of casinghead gasoline manufacturers relating to the price basis for computing royalty on casinghead gas in the Osage Nation, was adopted, jointly with the Association of Natural Gasoline Manufacturers:

Resolved by the Osage Oil and Gas Lessees Association and the Association of Natural Gasoline Manufacturers that the construction placed by the department on paragraph six of the rules approved March 7, 1923, in computing royalty on casinghead gas produced in the Osage Nation where sales are made by the producer or manufacturer of casinghead gasoline to an affiliated company is unjust to the producer of casinghead gas in the Osage Nation and violates both the letter and spirit of the regulations in that (a) it makes the words "arbitrary price" the equivalent of a stated or agreed price; and (b) where such sales are made, settlements are required under such construction to be on the average price for which such gasoline is sold as ascertained by the superintendent without regard to whether the price received approximates the market price or not; and (c) in that the superintendent only has power to compel settlemens on the average market basis when the price received by the producer from an affiliated company does not approximate the market price; and (d) The basis used to compute the market price is wrong, unjust and contrary to the rules, as the rules provide for the price being based on the open market and the term "open market" does not include in trade, law or ordinary usage price received on long term or special contracts between parties, and such construction does include such contracts in ascertaining the average price, and such price is further computed on a basis including finished products when the rule covers, and was intended only to cover, raw or unfinished products, and such construction also violates paragraph 12 of the oil lease in that it requires such producer to pay a royalty on a basis greater than the amount actually received by him.

Be it further resolved that the price actually received is the true basis for computing royalty in case of affiliated companies as well as others and it is only when the superintendent finds two facts to concur that he may require settlement by the affiliated company on basis of the average price, to-wit: (a) When the price reported by the affiliated company does not approximate the average price received in the open or spot market; and (b) When said price is found to be arbitrary. In determining whether the price received by an affiliated company approximates the average open market price received, it is insisted that the superintendent should take into consideration the quality or grade of the product sold.

Resolved, further, That these associations believe and recommend that the producers of casinghead gas should do all in their power to abrogate such unjust construction of the rules and to that end request the superintendent to enforce the rule according to its letter and spirit and when so enforced the rule needs no construction, and in order to facilitate an adjustment of the matter, request a conference with the secretary of the interior if the superintendent does not feel authorized to grant relief without instructions from the department.

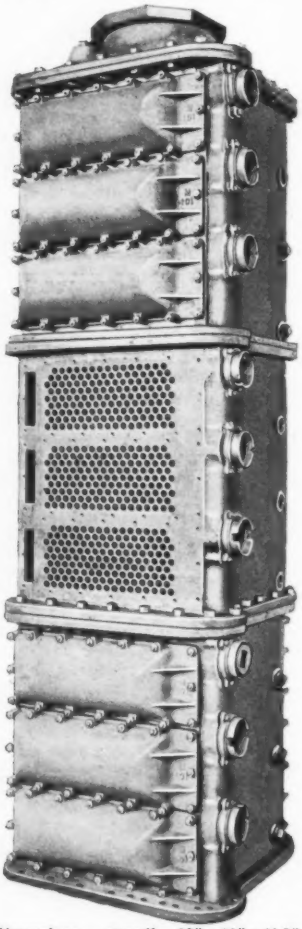
Tulsa, Okla.—A called meeting of traffic managers of the Western Petroleum Refiners Association was held here the first part of July to consider transportation matters affecting the organization.

Charleston, W. Va., July 25.—The Baltimore Gas Engineering Corporation of Charleston, West Virginia, has closed a contract with the Humphreys Carbon Company of Tulsa for the construction of a natural gasoline plant near Bastrop, Louisiana. The plant is of the absorption type and uses the charcoal process of gasoline extraction licensed by the Gasoline Recovery Corporation.

Beaumont Sparks, head of the refinery department of the Standard Oil Company of Indiana in Chicago, is staying in Casper for a short time.

Type B-540
Gasoline Condenser
(Patented)

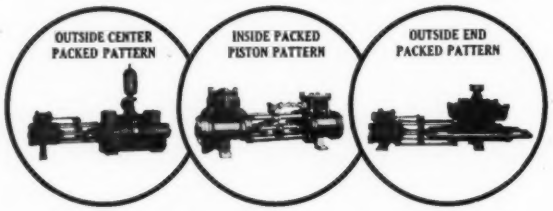
Compact — Efficient — Flexible



Dimensions — overall, 30" x 30" x 9'-0"
(inc. top and bottom bonnets)

SOUTHWESTERN CONDENSER COMPANY
1215-1221 Hollingsworth Bldg.,
Los Angeles, Calif.

DURABLE DUPLEX STEAM PUMPS



NEW YORK SALES OFFICE, 141 BROADWAY
Send for Catalog No. 107

DEAN BROS. CO. INDIANAPOLIS.

Think of a double Dubbs unit with a daily capacity for cracking 1000 bbls. of charging stock, yielding an average of more than 400 bbls. of good Navy IBP-EP gasoline each day, regardless of whether the stock is gas oil, topped oil or fuel oil

And this from what is left after you have taken every drop of gasoline out of the crude that you know how to get

Universal Oil Products Company
Owners of the Dubbs Process
208 South LaSalle Street Chicago

Mid-Continent Refinery Operations

AS OF JULY 15, 1923

Company and Location—	Daily Capacity	Now Running
Missouri—		
C. & C. Refining Co., Centropolis	400	S. D.
Ford Oil & Refining Co., Kansas City	500	S. D.
Standard Oil Co. of Indiana, Sugar Creek	12,000	8,500
St. Joseph Viscosity Oil Co., St. Joseph	500	RRC
Wilhoit Refining Co., Joplin	2,000	850
Kansas—		
Associated P. & R. Co., El Dorado	1,000	S. D.
Bell Producing & Refining Co., Wichita	700	S. D.
Commonwealth Oil & Refining Co., Moran	800	200
Derby Oil & Refining Co., Wichita	5,000	2,500
Chemical Oil & Gas Co., Osawatomie	1,000	S. D.
El Dorado Refining Co., El Dorado	4,000	1,600
Mecca Refining Co., Augusta	2,500	S. D.
Frontier Refining Co., Hutchison	2,000	1,000
Fugatt Giles Corporation, Wichita	100	S. D.
Golden Rule Refining Co., Wichita	800	825
Great Western Refining Co., Erie	1,500	S. D.
Great Western Petroleum Co., Florence	2,000	S. D.
H. & H. Refining Co., Osawatomie	1,000	S. D.
Imperial Refining Co., Cherryvale	2,400	S. D.
Kanotex Refining Co., Arkansas City	3,000	3,000
Kansas Oil Refining Co., Coffeyville	2,000	550
Kansas City Refining Co., Kansas City	5,000	2,200
Kansas-Texas Oil Refining Co., Wichita	1,500	S. D.
Lesh Refining Co., Arkansas City	1,500	800
Lakeside Refining Co., Augusta	2,500	600
Midland Refining Co., El Dorado	8,000	5,550
Mutual Oil Co., Chanute	1,500	425
Marshall & Company, Sheffield	2,500	S. D.
Moore Refining Co., Arkansas City	4,500	4,000
Mo-Kan Refining Co., Kansas City	1,000	S. D.
McCree Petroleum Co., Baxter Springs	600	S. D.
McWhorton-Chanute Refining Co., Chanute	200	S. D.
Miller Petroleum Company, Humboldt	1,500	700
National Refining Co., Coffeyville	5,000	4,700
North American Refining Co., Rosedale	700	S. D.
Peerless Oil & Refining Co., Chanute	2,500	1,750
Interstate Refiner, Inc., Centropolis	1,000	S. D.
Richardson Refining Co., El Dorado	2,000	600
Sinclair Refining Co., Coffeyville	7,000	4,600
Red Bird Refining Co., Fredonia	800	S. D.
Sinclair Refining Co., Argentine	6,000	6,000
Sterling Oil & Refining Co., Wichita	5,000	3,900
St. Louis Oil & Refining Co., El Dorado	1,500	S. D.
Standard Oil Co. (Kansas) Neodesha	12,000	8,600
Vickers Petroleum Co., Potwin	1,800	550
White Eagle Oil & Refining Co., Augusta	6,000	6,000
Oklahoma—		
Acme Refining & P. L. Co., Jennings	2,600	S. D.
Allied Refining Co., Okmulgee	2,000	900
Associated P. & R. Co., Yale	1,000	S. D.
Barnsdall Refining Co., Barnsdall	3,000	2,600
Bay State Refining Co., Healdton	1,000	S. D.
Beaver P. & R. Co., Dilworth	700	S. D.
Bison Refining Co., Quay	1,000	S. D.
Bolens Refining Co., Enid	3,600	1,525
Buffalo Refining Co., Yale	1,000	S. D.
Cushing-Burk Pet. Co., Cushing	1,000	850
Cameron Refining Co., Ardmore	3,500	2,100
Canfield Refining Co., Yale	500	100
Carter Oil Co., Cartoco	12,000	S. D.
Champlin Refining Co., Enid	15,000	5,000
Cherokee Refining Co., Oilton	1,000	S. D.
Chestnut & Smith Corp., Sand Springs	5,000	S. D.
Choat Oil Corp. (Now owned by Chas. F. Noble) Oklahoma City	2,200	S. D.
Coleman-Nelson Corp., West Tulsa	2,000	S. D.
Coleman-Nelson Corp., Haskell	1,000	S. D.
Constantine Refining Co., Devol	10,000	S. D.
Constantine Refining Co., West Tulsa	4,500	S. D.
Cosden & Co., West Tulsa	35,000	15,000
Cushing Refining & Gasoline Co., Cushing	2,500	1,600
Cyril Ref. Co. (Apex Pet. Co.), Cyril	1,200	400
Daisy Bell Petroleum, Wilson	2,000	200
Camascue Refining Co., Lawton	1,500	S. D.
Cushing Refining & Gasoline Co., Blackwell	1,500	1,200
El Dorado Refining Co., Yale	700	S. D.
Equality Refining Co., Oilton	1,000	S. D.
Empire Refineries, Inc., Cushing	5,000	3,300
Empire Refineries, Inc., Okmulgee	2,500	1,850
Empire Refineries, Inc., Oklahoma City	2,500	S. D.
Empire Refineries, Inc., Ponca City	4,500	3,400
Frances Refining Co., Frances	500	S. D.
Frederick Refining Co., Frederick	500	S. D.
Fairmont Refining Co., Fairmont	2,500	700
Federal Oil & Refining Co., Cushing	1,500	S. D.
Globe Oil & Refining Co., Blackwell	4,000	3,800
Gilmer Oil Co., Ringling	800	200
Golden Belt Refining Co., Oklahoma City	200	S. D.
Grandfield Oil & Refining Co., Grandfield	3,000	1,200
Great American Refining Co., Jennings	2,500	S. D.
Hewitt Refining Co., Hewitt	1,600	1,000
Home Oil & Refining Co., Yale	2,000	S. D.
Indian Oil & Refining Co., Cushing	1,800	S. D.
U. S. Cities Corp., Bristow	2,500	S. D.
Imperial Refining Co., Ardmore	5,000	4,000
Indiahoma Refining Co., Okmulgee	9,000	S. D.
Illinois Oil Co., Cushing	3,000	1,500
Inland Refining Co., Cushing	3,000	1,500
Johnson Oil Refining Co., Cleveland	2,500	1,600
Lawton Refining Co., Lawton	1,000	S. D.
Livingston Refiners Corp., Walters	3,000	S. D.
Local Refining Co., Oklahoma City	1,000	600
Marland Refining Co., Covington	1,000	500
Marland Refining Co., Ponca City	12,000	8,000
Mecca Refining Co., Allen	1,500	S. D.
Meridan Petroleum Co., Okmulgee	3,000	S. D.
Meridan Pet. Corp., Hominy	1,000	S. D.
Meridan Pet. Co., Ponca City	2,500	S. D.
Mid-Co. Petroleum Co., West Tulsa	7,000	S. D.
North American Refining Co., Pemeta	1,500	S. D.
Nyanza Refining Co., Wilson	3,500	500
Oil State Refining Co., Enid	2,500	800
Pontotoc Pipe Line & Refining Co., Allen	600	200
Omar Refining Co., Garber	2,500	1,650
Oklahoma P. & R. Co., Muskogee	2,500	1,600
Pawhuska Refining Co., Pawhuska	1,000	100
Waite Phillips Co., Okmulgee	3,000	1,600
Pierce Oil Corp., Sand Springs	9,000	5,550
Polar Producing & Gasoline Co., Sapulpa	2,000	S. D.
Producers & Refiners Corp., Blackwell	2,500	2,000
Producers & Refiners Corp., West Tulsa	6,000	4,050
Pure Oil Co., Ardmore	7,000	3,400
Pauline Refining Co., Hampton	1,200	500
Pure Oil Co., Cushing	6,500	3,000
Powerine Oil Co., Billings	500	S. D.
Pioneer Petroleum Co., Guthrie	2,500	S. D.
Pirtle-Pittman Refining Co., Newkirk	2,000	200
Rock Island Refining & P. L. Co., Duncan	1,200	900
Santa Fe Oil & Refining Co., Ardmore	5,000	S. D.
Shaffer Oil & Refining Co., Cushing	6,500	4,000
Sapulpa Refining Co., Sapulpa	7,000	4,000
Southern Oil Corp., Yale	6,000	S. D.
Southern Oil Corp., Walters	2,500	S. D.
Sun Co., Yale	4,000	2,400
Southwestern Oil Corp., Enid	1,800	S. D.
Sinclair Refining Co., Cushing	5,500	5,000
Sinclair Refining Co., Muskogee	2,000	1,000
Texas-Okla Refining Co., Grandfield	1,500	1,200
Texas Co., West Tulsa	8,000	7,500
Tidal Refining Co., Drumright	4,500	3,800
Transcontinental Oil Co., Boynton	3,000	2,000
Transcontinental Oil Co., Bristow	5,000	5,000
Travis Senter Refining Co., Commanche	2,500	650
Union Oil & Refining Co., Grandfield	2,500	S. D.
Turley Refining Co., Oklahoma City	2,500	S. D.
Wagoner Refining Co., Wagoner	500	S. D.
Wilcox Refining Co., Bristow	500	500
Yale Oil Corp., Yale	1,200	550
North Texas—		
American Oil Corp., Pioneer	2,500	1,000
American Refining Co., Wichita Falls	5,000	4,600
H. E. Boner, Burkburnett	700	S. D.
The Petroleum Corp., Electra	2,000	500
Buffalo Refining Co., Sherman	500	150
Burk-Texas Refining Co., Burkburnett	1,200	S. D.
Bear Refining Co., Burkburnett	1,200	S. D.
Clayton Oil & Refining Co., Dallas	3,500	800
Crystal Petroleum Co., Burkburnett	1,000	300
Eastland-Pioneer Oil & Refining Co., Cisco	1,000	S. D.
Empire Refineries, Inc., Gainesville	7,000	3,900
General Refining Co., Abilene	1,500	S. D.
Gulf Refining Co., Ft. Worth	15,000	5,600
Gorman Refining Co., Gorman	1,000	S. D.
Griswold Oil Co., Electra	2,000	1,600
Humble Oil & Refining Co., Burkburnett	1,500	1,200
Invincible Oil Corp., Ft. Worth	5,000	S. D.
Interstate Gasoline Product Co., Iowa Park	2,000	810
Iowa Park Prod. & Refining Co., Iowa Park	1,000	500

UNION OIL FIELD LINE

UNION STEAM PUMP CO.

BATTLE CREEK, MICH.

REFINERY AND GASOLINE PLANT ACTIVITIES

Specifications on Gasoline and Lubes Are Changed Effective Next January

Washington, D. C.—Recommendations for the revision of Federal specifications for gasoline, kerosene, fuel and lubricating oils were made last week by the Federal specifications board. The new specifications would become effective January 1, next. The changes were recommended by representatives of the petroleum industry.

The concrete recommendations are that a limit of one-tenth of 1 per cent be placed on the total sulphur in all grades of gasoline, to be determined by the lamp method; that the unsaturation test be eliminated or made more lenient; and that the specifications for motor gasoline be known as United States Government motor gasoline. The only other change of importance recommended in regard to gasoline was to discontinue the use of cotton on the bulb of the distillation thermometer.

Refiners present at the board also recommended that the sulphur limit on kerosene be raised to .125 per cent, and that the burning test be increased to 16 hours. It was recommended that the committee follow the recommendation of the signal section of the American Railway Association in regard to the specifications for long time burning oil.

The main change on lubricating oils recommended was the new American Society for Testing Materials method for determining color. The question of carbon residue limits in the various oils was discussed, and there was also some discussion of fuel oils.

Representatives of the petroleum in- E. B. Phillips, Sinclair Refining Company; Jas. T. B. Bowles, Tide Water Oil Company; T. G. Delbridge, Atlantic Refining Company; Van H. Manning, American Petroleum Institute; A. J. Turner, representing California refineries; Harmon F. Fisher, American Petroleum Institute; W. A. Edmundson, Gulf Refining Company, F. W. Clark, Tide Water Oil Sales Corporation; O. P. Keeney, National Petroleum Association; F. D. Shields and Sidney Born, Transcontinental Oil Company; E. W. Dean, Standard Oil Company of New Jersey; Fayette B. Dow, National Petroleum Association; Willis Crane and Elwin A. Hadlick, Western Petroleum Refineries Association; H. T. Bennett, Cosden & Company; C. E. Smith, Cacuum Oil Company, and G. W. Gray, the Texas Company.

The recommendations made by the oil industry's men were considered at a private meeting of the committee on lubricants and liquid fuels, the result of which meeting has not yet been made public.

Powell-Corsicana Field Has Gasoline Plant Attractions

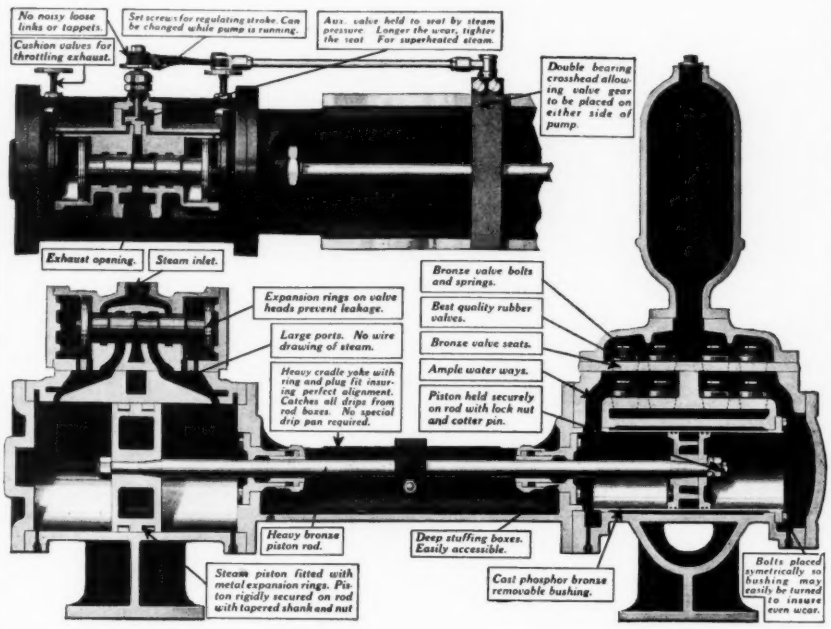
Corsicana—Possibilities of a number of natural gasoline manufacturing plants being erected in the newly developed Corsicana-Powell field are now considered bright as result of favorable tests made on the gasoline contents of the huge quantities of gas accompanying the flow of oil is the field. Although the gas in the northeast end of the field around the discovery well, where crude tests 31 gravity, shows only about two tenths of a gallon per thousand cubic feet, the recovery jumps to nearly one and one-half gallons per thousand from wells on the McKie and Blumrosen leases near the creek. Crude produced on the latter two leases runs 35 gravity and slightly better, and becomes richer in gasoline content further southwest. While no gasoline test has yet been announced on Humble's G. Kent well, which extended the field about one mile further southwest middle of July, it is interesting to note that this well is producing 38.3 gravity crude, and will undoubtedly show a much higher recovery when tested and compared with wells in the opposite end of the field. The major companies having producing leases in this field are beginning to investigate the possibilities of plants being operated profitably, and some are expected to build.

Oklahoma City, Okla.—As a last resort, the Oklahoma corporation commission has announced that unless crude oil refiners and natural gasoline manufacturers in the State submit a full report of operations by August 1, they will be cited to show cause why they should not be declared in contempt of that body's order asking for the information.

Company and Location—	Daily Capacity	Now Running
Keystone Ranger Refining Co., Wichita Falls	2,000	S. D.
Lone Star Refining Co., Wichita Falls	4,000	600
Manhattan Refining Co., Burkburnett	3,000	S. D.
Manhattan Petroleum Prod. Co., Wichita Falls	2,500	300
Miller Petroleum Co., Wichita Falls	2,500	1,600
Magnolia Petroleum Co., Ft. Worth	12,500	5,550
Noble Oil & Gas Co., Burkburnett	5,000	850
Nortex Refining Co., Burkburnett	2,000	700
North Texas Refining Co., Greenville	1,000	S. D.
Owenwood Oil Corp., Burkburnett	2,000	S. D.
Oriental Refining Co., Dallas	5,000	500
Odessa Refining Co., Ranger	1,000	S. D.
Orient Petroleum Co., Wichita Falls	2,000	400
Pierce Oil Corp., Ft. Worth	10,000	S. D.
Panhandle Refining Co., Wichita Falls	4,500	3,250
Atlas Refining Co., Ft. Worth	2,000	S. D.
Primrose Refining Co., Wichita Falls	1,500	400
Interstate Refiners, Inc., Ranger	2,500	S. D.
Haggemen Refining Co., Tiffin	2,000	200
Star Refining Co., Ft. Worth	1,500	400
State Refining Co., Dallas	1,000	200
Sunshine State Refining Co., Wichita Falls	2,500	800
Tidal Western Refining Co., Burkburnett	3,000	1,800
Texas Co., Dallas	15,000	7,500
Texhoma Oil & Refining Co., Wichita Falls	4,500	2,000
Transcontinental Oil Co., Ft. Worth	5,000	1,800
Travis Refining Company, Burkburnett	1,000	250
Great Texas Refining Co., De Leon	700	S. D.
Uniform Petroleum Co., Burkburnett	4,000	S. D.
Virginia Refining Co., Dublin	4,000	S. D.
Victor Refining Co., Burkburnett	2,000	S. D.
Wagoner Refining Co., Electra	3,500	600
Walker Consolidated Refining Co., Iowa Park	2,500	S. D.
White Eagle Oil & Refining Co., Ft. Worth	5,000	4,000
Waco Refining Co., Waco	500	S. D.
World Refining Co., Bridgeport	800	S. D.

Company and Location—	Daily Capacity	Now Running
Louisiana—		
Caddo Central Oil & Refining Co., Shreveport	3,500	S. D.
Caddo Central Oil & Refining Co., Shreveport	7,000	5,000
Crescent Oil & Refining Co., Cedar Grove	600	S. D.
Homer Refining Co., Homer	250	S. D.
International Oil & Refining Co., Shreveport	800	S. D.
Leeton Refining Co., Shreveport	800	S. D.
Louisiana Petroleum Products Co., Bossier	300	S. D.
Louisiana Oil Refining Co., Shreveport	9,000	4,850
Paramount Pet. Co., Superior	3,000	S. D.
Red River Refining Co., Crichton	1,800	1,400
Rogers Refining Co., Shreveport	1,200	S. D.
Shreveport P. & Refining Co., Shreveport	4,500	4,000
Texas Co., Arlds	5,000	4,500
Union Refining P. L. Co., Oil City	1,000	S. D.
Union Refining P. L. Co., Homer	1,000	S. D.
Arkansas—		
Abner Davis, El Dorado	60	S. D.
Airedale Refining Co., El Dorado	1,000	S. D.
Arkansas Oil Refining Co., Ft. Smith	1,000	S. D.
Arkansas Prod. & Refining Co., El Dorado	1,000	800
El Dorado L. & Refining, El Dorado	2,000	S. D.
Grison Refining Co., El Dorado	750	S. D.
Jones Brothers & Tatum, El Dorado	1,000	400
Kettle Creek Refining Co., Pearson	2,000	1,500
Lions Oil & Refining Co., El Dorado	5,000	4,500
Pine Bluff Refining Co., Pine Bluff	1,000	800
Root Refineries, El Dorado	3,000	1,200
Shippers Petroleum Co., El Dorado	1,800	400
Union Pipe Line & Refining Co., El Dorado	4,000	800
The Arkansas Refining Co., Ricron	3,000	S. D.
Farmer Oil & Refining Co., Texarkana	1,000	200
Four State Refining Co., Texarkana	400	S. D.

American-Marsh Refinery Pumps


No noisy loose links or tappets.
Set screws for regulating stroke. Can be changed while pump is running.
Aux. valve held to seat by steam pressure. Longer the wear, tighter the seat. For superheated steam.
Cushion valves for throttling exhaust.
Double bearing crosshead allowing valve gear to be placed on either side of pump.
Exhaust opening.
Steam inlet.
Bronze valve bolts and springs.
Expansion rings on valve heads prevent leakage.
Best quality rubber valves.
Large ports. No wire drawing of steam.
Bronze valve seats.
Heavy cradle yoke with ring and plug fit insuring perfect alignment. Catches all drips from rod boxes. No special drip pan required.
Ample water ways.
Piston held securely on rod with lock nut and cotter pin.
Heavy bronze piston rod.
Deep stuffing boxes. Easily accessible.
Steam piston fitted with metal expansion rings. Piston rigidly secured on rod with tapered shank and nut
Cast phosphor bronze removable bushing.
Bolts placed symetrically so bushing may easily be turned to insure even wear.

The illustration tells its own story. Why the American-Marsh is the logical pump for use in your refinery.

Note the extra wide passages and large valve area which make them especially adapted for handling oil and other refinery products.

The line includes:
Centrifugal Pumps
Acid Pumps
Oil Pumps
Dry Vacuum Pumps
Air Compressors
Jet Condensers
Hydraulic Pressure Pumps

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Battle Creek, Mich.

CHESTNUT & SMITH CORPORATION

Natural Gasoline Blends
All Grades

General Offices
Chestnut & Smith Corporation Building, Tulsa, Oklahoma

Empire Plans Compressing Station at Cambridge, Kansas

Bartlesville, Okla.—A gas compressing station, which will contain four 485 horsepower Cooper single tandem gas engines directly connected to 15x36 Cooper plate valve compressors, will be built by the Empire Companies at Cambridge, Kansas, according to plans which have been announced by the gas division of the Empire Companies.

A deal has been consummated covering the purchase of a site containing approximately 20 acres for the new plant, which lies directly north of the present property.

Plans for the new station are rapidly nearing completion and it is expected that actual construction work will begin within a few days. The latest and most improved methods of construction will be used in building this plant. All buildings will be of steel frame corrugated iron construction; the auxiliaries will consist of gas engine driven generators furnishing power for motor driven water pumps, air compressors, etc.

The new station will have an approximate daily capacity of 40,000,000 cubic feet. This gas will be supplied through the Dilworth 16-inch, Caney 12-inch and the Elk County 8-inch lines and will be delivered directly into the Wichita, Hutchinson, Newton and the towns of the Western Distributing Company.

Established 1867

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Vilter-Milwaukee typifies the true standard of reliability in machinery construction and refrigerating engineering.

Vilter Low Temperature Compression System (for efficiently producing low temperatures with compression system.)

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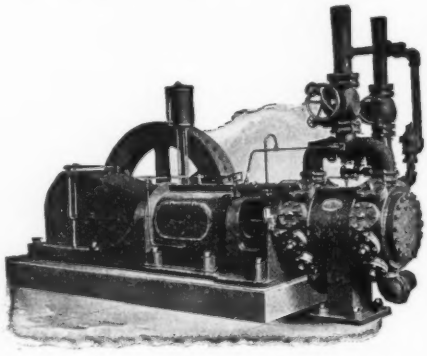

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Agitators Tanks Towers
Walkways and Stairs

Large Stocks of Materials Prevent Delays
Efficient Shop Service

MASHER

STEEL AND MACHINERY COMPANY
DALLAS, TEXAS

Carbon Black Plant Expects To Start Operation October

Breckenridge, Texas.—The first unit of the 12,000,000 cubic foot daily capacity carbon black plant being erected on the Ackers lease north of Breckenridge in Stephens County by the Texas Carbon Industries, Inc., is to be placed in operation on the first of October, and will consist of 30 burning houses. When completed the plant will have a total of 90 burning houses of which 30 are to be erected and ready for use by the last of November, and the remaining 30 on the first of the new year. The estimated cost of the plant when completed is placed at $400,000. and it is reported the recovery per 1000 cubic feet of gas will average one pound of carbon black. The raw material for the plant is obtained from nearby natural gasoline manufacturing plants.

The Texas Carbon Industries, Inc., is organized under the laws of Delaware with a capitalization of $550,000, and was recently chartered in this state, with state headquarters at Breckenridge. The officers of the company are Bert Blair, president; C. K. Springfield, vice president; C. N. Avery, secretary, and Ewell Nolle, treasurer.

Work Progressing on Small Plant North of Paris, Texas

Paris, Texas.—Construction work on the Paris Refining Company's 500-barrel capacity skimming plant, located north of Paris on the tracks of the Santa Fe Railroad, is nearing completion, and it is planned to begin operations about the middle of August. The plant represents an investment of approximately $50,000, and the owners have announced that when it is completed work will begin on the erection of a lube plant on the same site. Crude will be obtained from the Gulf Pipe Line Company's Texas-Oklahoma trunk line, which lies near the refinery.

The Paris Refining Company contemplates marketing the bulk of its gasoline locally and in nearby points in Texas and Oklahoma, and will have headquarters at the refinery. The officers of the company are: H. D. Brown of Paris, a veteran producer and refiner, president and general manager; W. E. Floding of Atlanta, Ga., vice president; E. L. Norton of Paris, secretary-treasurer; Lon Gilmore, plant superintendent, and Elmer Brandt, assistant superintendent.

Explosion Causes Fire in Penn-American Refinery

Oil City, Pa.—Fire caused by an explosion in a vapor line at the Oil City plant of the Penn-American Refining Company the latter part of June for a time threatened the whole works but later was brought under control with the aid of fire fighting apparatus from Franklin and Titusville.

Soon after the explosion the fire spreak toward a number of tanks filled with gasoline and benzine and fear was expressed for the safety of Rousville, a suburb in which the Penn-American refinery, a $2,000,000 plant is located.

Dutch-Shell Contracts for Use of Silica-Gel Process

Baltimore, Md.—A contract has been successfully negotiated between the Davison Chemical Corporation and the Royal Dutch-Shell interests for the use of the Silica Gel process for refining oils. The contract gives the Dutch-Shell interests the right to use the process in all its plants in this country and abroad and does not prohibit the Davison Chemical Corporation from entering into similar contracts with other refining companies. The contract is on a royalty basis and will average about 10 cents a barrel for all refined products, including gasoline, kerosene and other products.

The Royal Dutch-Shell will employ the process at its New Orelans refining plant, it is understood here, and probably at the Roxana Petroleum Company's new plant now building at Arkansas City, Kansas, in the Mid-Continent field in the Southwest.

The Davison Chemical Corporation advises that negotiations are under way with other companies for use of the Silica Gel process.

Work Starts on White Eagle Plant Near Casper, Wyo.

Casper, Wyo.—Preliminary work on the construction of a new modern refinery east of Casper, recently announced by the White Eagle Oil and Refining Company, is already under way and E. C. Marshall, superintendent of White Eagle refineries, and S. W. Irwin, construction engineer, are on the ground. It is understood here that virtually all of the steel has been ordered.

The initial capacity of the refinery will be 2,000 barrels.

With the completion of the Wyoming plant, which will operate on Salt Creek crude, White Eagle will have a combined refining capacity of some 15,000 barrels a day. Company already operates modern refineries at Augusta, Kansas, and at Fort Worth, Texas. Executive offices of White Eagle are located in Kansas City, Missouri.

Wichita Falls, Texas—Re-organization of the Fay Petroleum & Refining Company, which has been operating a 1,000 barrel daily capacity skimming plant and a natural gasoline manufacturing plant near South Bend, Young County, has been completed, and the name changed to Century Oil & Refining Company. The incorporators of the company are: R. G. Pearson, L. Z. Grace and T. B. Wenningham, with a capital stock of $150,000.

Washington, D. C.—On the recommendation of the royal experimental station for oils and greases of Milan the Italian ministry of industry and commerce has appointed a technical commission to study the necessity for establishing standard specifications covering petroleum. It is pointed out that it is desirable to determine specifications for the various oils both to guide the producer and to protect the consumer from choosing a product that is not suited to his needs.

Four Units of Dubbs for Santa Fe Ardmore Plant

Ardmore, Oklahoma.—The Santa Fe Oil and Refining Company, which has purchased the plant formerly operated by the Chickasaw Refining Company, north of Ardmore, has closed a contract with the Universal Oil Products Company for the construction at the local plant of four units of the Dubbs process stills, it is reported by officials. The installation of the new apparatus will cost approximately $300,000. The Universal Company is now completing four Dubbs units at the Pure Oil refinery in Ardmore and has completed two units at the Texas-Pacific refinery in Wynnewood. The Santa Fe plant has been thoroughly overhauled.

Oklahoma City, Okla.—It is expected that the new natural gasoline plant being erected in Seminole County in this state will be in operation by the middle of July or before. The plant is located on the Foster lease which is owned by the Smith interests. The Wewoka plant is being built by H. R. Smith.

Washington, D. C.—The United States shipping board announces the closing of a contract with the Texas Company for the transportation of case oil from U. S. Gulf ports to south and east African ports during the last half of this year. The contract is an extension of the agreement made with the Texas Company at the time the South African service was inaugurated.

Complete Refinery Equipment

Our knowledge of the business and facilities at our disposal enables us to render a well-rounded and dependable service to Refiners not only in the Mid-Continent field but on the West Coast as well.

We maintain an experienced field organization.

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Expansion Drums
Stacks
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Blow Cases
Grease Kettles

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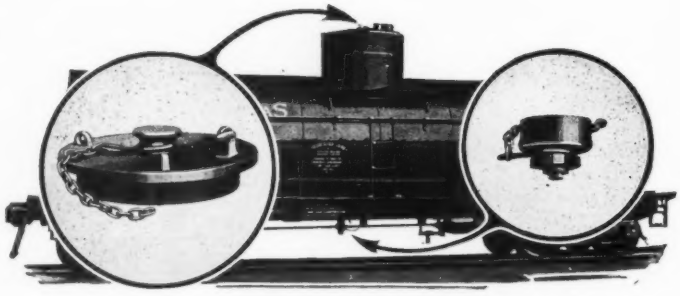
703 Orear Leslie Bldg., Kansas City, Mo.

Increase Capacity of Plant In Stephens County Section

Breckenridge, Texas.—Approximately $150,000 is being expended by the National Gasoline Company of Fort Worth on increasing the capacity of its natural gasoline manufacturing plant located on the Walker & Caldwell lease near Breckenridge. Four Bessemer and the same number of Clark gas engines are being added to the plant, while the increased capacity will necessitate laying off about three miles of 10-inch gathering lines for gas. The construction work is under the direct supervision of W. L. Sealy and George Oberfeld, engineers of Breckenridge. It is planned to have the new equipment in operation within 30 days, and it will bring the capacity of the plant up from five to twelve million cubic feet of gas daily, or an output of about 15,000 gallons of gasoline daily. T. E. Patton is in charge of the plant and is also general superintendent for the company, which also owns an absorption plant in Pioneer field.

Kansas City Mo.—Approximately 40 acres, adjoining its Twenty-First Street refinery site, has been purchased by the Derby Oil and Refining Company at a cost of $35,000. The former site occupied 45 acres, and has recently become too small to comfortably house the operations of this company. An increase in refinery facilities is being hinted at in local circles.



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Tank cars can't be loaded or shipped without flawless Dome Cover and Outlet Cap equipment. Don't wait until loading time to find out your supply is exhausted.

Send in your order today by wire or letter. We have complete stocks on hand ready for immediate shipment in any quantity. Best prices and good discounts.

We are especially adapted to handle your wants in: Brake Shoes, Gray Iron Castings, Plate Work, Beams, Sheet and Structural Steel.

Oil Well Rig Irons and Refinery Equipment

Western Iron & Foundry Co.

Wichita, Kansas

Sunburst Refinery Near Casper Starts Operation

Great Falls, Mont.—Fires have been started under the stills at the Sunburst Refining plant here, and the new refinery should be in full operation by the end of the week.

A small flow of gas has been found at 780 feet by the Flynn Bros. drilling on the Ragged Point structure near Melrose, Montana. A rotary outfit was used in drilling.

The Western States Oil Co., one of the operating companies in the Mountain States district for the Haskell interests, is reported to have acquired more than 65,000 acres of leases from the various interests in Western South Dakota.

The Homestake Oil Co. No. 11 on Sec. 10-15-29 of the Kevin-Sunburst field, is rated to have an initial production of about 100 barrel at 1450 feet.

Move Plant from Burkburnett To New Archer County Field

Wichita Falls, Texas.—A 250-barrel daily capacity skimming plant consisting of one pipe still is being moved from Burkburnett to the Swastika oil field in southwest part of Archer County on G. T. & W. railroad near the town of Megargel by A. A. Spencer, Manross and others of Wichita Falls, and will be operating on crude in this field within a few weeks. The output of the plant is to be sold through the Exchange Petroleum Company of Wichita Falls.

Oklahoma City, Okla.—Plans have been completed, company officials announce, for the installation of a cracking process at the Cyril, Oklahoma, refinery of Anderson-Pritchard Oil Corporation which has general offices here. The installation work will entail an expenditure of approximately $75,000.

The Cyril plant of Anderson-Pritchard Corporation is rated as a 1,200 barrel refinery.

New Gasoline Company Gets Charter for Texas Business

Austin, Texas.—Benwick Gasoline Company has been granted a charter with a capitalization of $60,000 to operate a natural gasoline manufacturing plant in Texas. Headquarters are at Eastland, and the following are the incorporators: I. N. Berry, L. R. Pearson and F. L. Berry.

Fort Worth, Texas.—Charlie Brooks, 50, well known natural gasoline manufacturer in the Mid-Continent district and a member of the firm of Brooks & Hanlon, Inc., of Breckenridge, Texas, died June 22 while on a visit in Colorado Springs, Colo. The remains were brought to Fort Worth for burial.

Toronto, Canada—The new 3,500 barrel refinery of the Imperial Oil Company, Ltd., being erected at Calgary at a cost of more than $2,000,000 is expected to be ready for operation about September 1, according to A. M. McQueen, vice president of the company. The refinery will operate on Salt Creek, Wyoming, and Montana crude oil.

UNITED IRON WORKS, INC.

KANSAS CITY, MO.

BUILDERS OF

Cross Process Gasoline Plants

SIX UNITS NOW BUILDING

We are now building Cross Process Gasoline Plants for large refineries in the states of Texas, Kansas, Pennsylvania, Nebraska and Wyoming.

WE ARE SPECIALIZING

in the manufacture of component parts for Cross Process Gasoline Plants—and can furnish Cast Steel Furnace Fittings, Iron Castings, Cooler Boxes, Towers and Structural Steel, according to Cross-Widdell specifications.

We are in a position to promptly handle your requirements. And we'll be glad to quote you without obligation.

UNITED IRON WORKS, Inc.

TULSA KANSAS CITY, MO. DALLAS

Tell them where you saw the ad

REFINERY SUPPLIES

Refiner's Chemicals Hold Steady During June—Miscellaneous Oils Report Decline

Chicago, July 16.—A normal demand has characterized the chemical market for the past month, and there has been little real news in the market, prices having remained steady for the most part. The only price advance recorded, in chemicals of interest to refiners, was a 5 cent advance per cwt. on Nitrate of Soda, or from $2.40 to $2.45. This advance was an arbitrary action on the part of importers, ascribed to a mere desire on their part to experiment and see if an advance would stimulate demand. The advance has failed, however, to have any effect on buying. In chemicals generally, contract withdrawals are reported as good and the export demand as having recovered.

Litharge declined 50 cents, consumers having shown an unwillingness to buy at higher prices.

OIL JOBBERS SUPPLIES

Prices based on original packages in large quantities f. o. b. manufacturing point—unless otherwise specified.

Animal, Fish and Vegetable Oils

Lard Oils—	Price July 15
Prime, bbls., lb.	14¼
Extra Winter, Strained, bbls. lb.	12
Extra, bbls., lb.	11¼
Extra No. 1, bbls., lb.	10½
No. 1, bbls., lb.	10
No. 2, bbls., lb.	9½
Tallow, prime edible, lb.	8½
Tallow Oil, acidless, bbls., lb.	10½
Lard Stearine, bbls., lb.	13½
Oleo Stearine, bbls., lb.	9¼
Neatsfoot Oil—	
Pure 20, cold test, bbls., lb.	15½
Pure 30, cold test, bbls., lb.	13¼
Extra, bbls. lb.	10½
No. 1, bbls., lb.	10
Horse Oil, bbls., lb.	7½
Red Oil, distilled, bbls., lb.	9¾
English Degras, bbls., lb.	3¾ 4¼
Domestic Degras, bbls., lb.	4 4¼
Menhaden Fish Oil—	
Light Pressed, bbls., gal.	.70 .75
Yellow bleached, bbls., gal.	.73 .78
Herring Oil, tanks, coast, gal.	.42 .45
Whale Oil, bleached, bbls., gal.	.81 .83
Sperm Oil, bleached, bbls., gal.	.89 .94
Soya Bean Oil, pressed, bbls., lb	.12 12¼
Soya Bean Fatty Acids, tanks, West lb.	12
Tallow Fatty Acids, bbls., lb.	.07 .07½
Castor Oil—	
No. 1, bbls., lb.	14½
No. 3, bbls., lb.	14

NAVAL STORES

(Quotations by National Rosin Oil & Size Company, Chicago.)

Rosins—		
B. to I. bbls. (280 lbs.)	$5.80	$6.00
10-20 bbl. lots, f. o. b. shipping point		7.10
K. to WW bbls., (280 lbs.)	6.00	7.50
10-20 bbl. lots, f. o. b. shipping point	6.90	9.00
Turpentine spirts ex yard gal.		.93
In drums		.91
Rosin Oil, first run, gal.		.46
Rosin Oil, second run, gal.		.48
Rosin Pitch, bbl.		6.00
Tar, kiln burned		13.50
Tar, retort		12.50

REFINERS' SUPPLIES

Prices are based on original packages, in large quantities, and represent spot quotations, unless otherwise stated, f. o. b. manufacturing points.

(Quotations by Wishnick-Trumpeer Chem. Co., Chicago.)

Soda Ash, light bags, cwt.	1.75	2.10
Silicate of Soda, 60 deg., tanks cwt	1.60	
Sal Soda, cwt.	1.15	1.25
Caustic Soda 76% drums cwt.	3.26	3.75
Chlorate of Soda, kegs, lb.	6½	7
Nitrate of Soda, cwt.	2.45	
Potash Permanganate	16¾	18
Potash Bichromate, sacks, lb.	10¾	11
Sulphuric Acid, 66 deg., tank cars ton	15	16
Acetic Acid—		
28% bbls., cwt.	3.38	3.63
56% bbls., cwt.	6.78	7.13
80% bbls., cwt.	11.41	11.60
Fullers Earth, 16-30 mesh, carloads, ton	$23.00	25.00
Chloride of Lime, cwt.	2.00	2.25
Benzol, pure, water white, gal.	.27	.32
Benzol, 90%, gal.	.25	.30
Toluol, gal.		30

Litharge

Chicago market, bbl. $10.40

PIONEER TANK & BOILER COMPANY

TULSA BOILER & SHEET IRON WORKS

A New Name for an Old Friend

WHAT'S in a name, anyway? The refinery construction work we are doing under the name "Pioneer" is just the same high grade as when it bore the name "Tulsa Boiler and Sheet Iron."

For eighteen years, as the "Tulsa Boiler and Sheet Iron Works" we have turned out tanks and refinery steel construction that made good friends for us among the wise buyers of the Mid-Continent. We pioneered in giving these people "close to home" service on the best kind of work.

Now, under the new name, The Pioneer Tank and Boiler Company, we're all set with the men, machinery and money to keep on growing under the Pioneer banner like we did when Tulsa Boiler and Sheet Iron was on our letterhead.

There is no change in our organization.

Get Pioneer quotations on tank and refinery construction work.

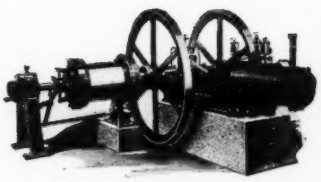
PIONEER TANK & BOILER COMPANY
(Formerly Tulsa Boiler and Sheet Iron Works)
Box 1926, TULSA, OKLA.

Electrically Driven Centrifuges
Hand Centrifuges
WRITE
WILLIAMS, BROWN & EARLE, Inc.
Manufacturers of Laboratory Apparatus
918 Chestnut St. Philadelphia, Pa.

FOR SALE

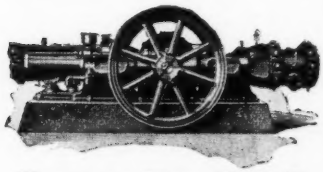
One 8½" x 4½" x 10" two stage type 10-B Ingersoll-Rand Air Compressor suitable for Gasoline Plant Service. Pulley 10" face, 53" diameter. In use about six months; discarded for larger unit.

Monongahela West Penn Public Service Company
Fairmont, W. Va.



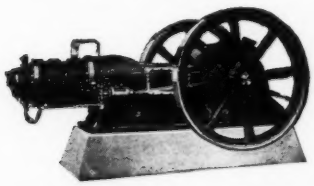
The Bessemer Oil Field Engine

Famous in deep oil territory the world over. Deep territory proves the worth of an engine and clutch. The original two-cycle engine, built with cross-head, has no valves exposed to exploding gases and has a score of exclusive features.



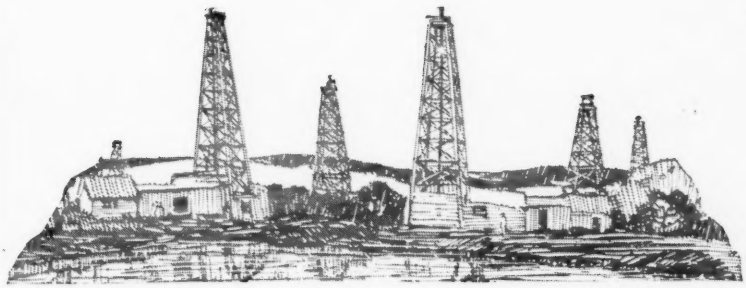
Bessemer Type VIII-B
(With Bessemer Compressor Cylinder)

Combining engine and compressor in one unit saves floor space, belting expense, foundation and installation costs, and insures reliable and efficient service. Standard equipment in the Gasoline-from-Gas Industry.



Bessemer Type IV Oil Engine
(15 to 115 H. P.)

Firmly established in its popularity, this engine with enclosed crank case, cross-head construction, patented combustion chamber and other features is without an equal for economical trouble-free performance.



REASONS WHY

"You Buy the Best When You Buy the Bessemer"

Twenty-five years specialization in the design, manufacture and servicing of oil field equipment has brought to Bessemer its unassailable position of leadership.

Skilled Design

Skilled engineers design and adapt each item to its specific use in the field. Engineering data is gathered first-hand under actual operating conditions.

Honest Manufacture

Every Bessemer product is built of the best materials—by skilled workmen. Each engine must pass a rigid inspection and test before it is passed as O. K. to carry the Bessemer trade-mark.

Universal Service

Bessemer has kept pace with the Oil Industry. Wherever new fields have developed, Bessemer has immediately established service centers.

Thirty-five such centers in the United States plus representation in foreign fields assure Bessemer users the world over, an unexcelled service and protection against costly delays.

Whatever your oil field need, there is Bessemer equipment that will exactly meet your requirements. Our engineers will be glad to consult and co-operate with you to fill your needs with the best and cheapest method.

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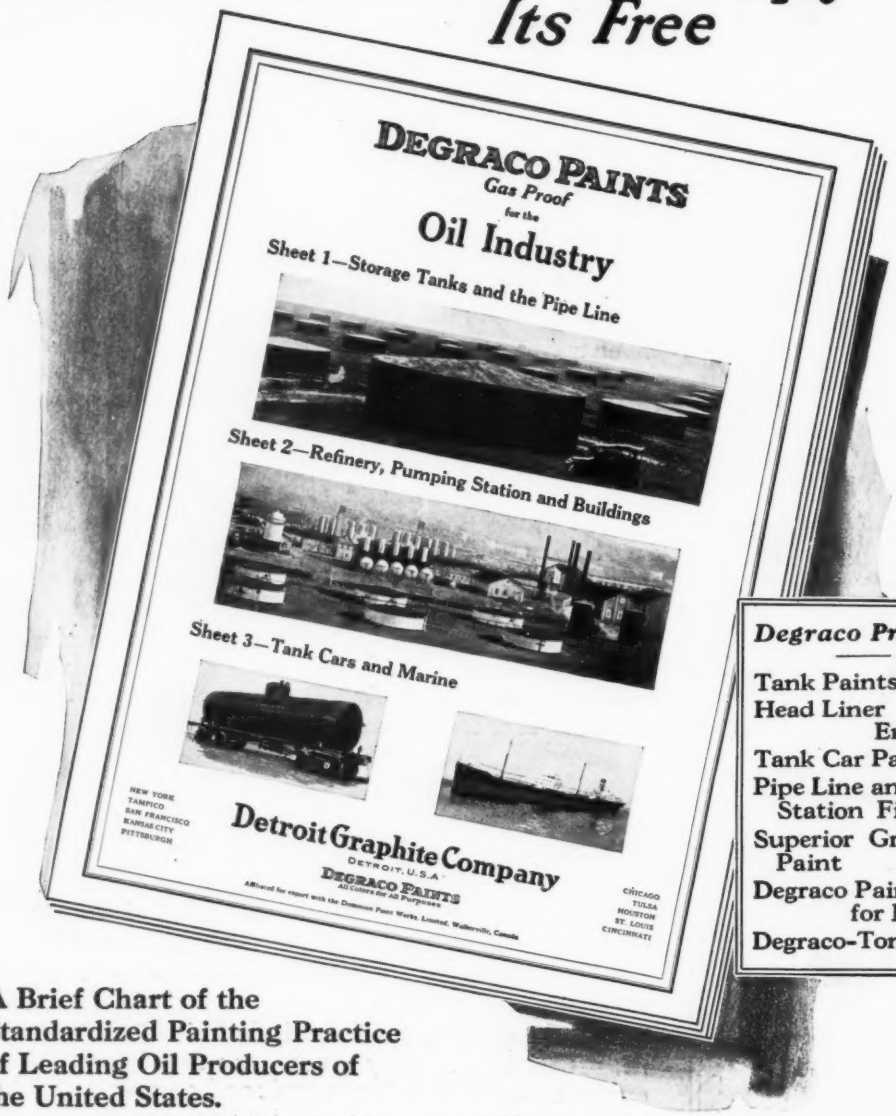

Degraco Products

Tank Paints
Head Liner Enamels
Tank Car Paints
Pipe Line and Station Finishes
Superior Graphite Paint
Degraco Paints for Houses
Degraco-Tone

A Brief Chart of the Standardized Painting Practice of Leading Oil Producers of the United States.

Detroit Graphite Company
563 Twelfth St., Detroit, U. S. A.

NEW YORK
CHICAGO
TULSA
ST. LOUIS
SAN FRANCISCO
TAMPICO
HOUSTON
KANSAS CITY
PHILADELPHIA
PITTSBURGH

DEGRACO PAINTS are sold through branch offices with warehouse stocks in all principal cities.
Manufactured in Canada by Dominion Paint Works, Ltd., Walkerville, Canada.

DEGRACO PAINTS VARNISHES ENAMELS
All Colors for All Purposes

Name.....
Position.....
Company Name.....
Address.....
State.....
Detroit Graphite Co. Detroit, Mich.